

KENYA COLONY AND PROTECTORATE



Department of Agriculture Annual Report 1934

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Annual Report of the Department of Agriculture, 1934

VOLUME II

Plant Industry

REPORT OF THE INVESTIGATIONAL SERVICES DIVISION OF PLANT INDUSTRY

FOREWORD

This volume of the Annual Report of the Department of Agriculture for the year 1934 contains a detailed account of the investigational work carried out during the year by the Division of Plant Industry. It is published in the form of reports by the heads of specialist sections and by agricultural officers in charge of field investigations in both European and native areas. The report of the officer in charge of grassland improvement is published in the *East African Agricultural Journal* for January, 1935, and is not therefore included in this volume; a copy of his report will be sent on application by those interested.

The chief centres of activity for the work in European areas are: (a) the Scott Agricultural Laboratories, which are the headquarters of the Coffee, Entomological, Botanical and Chemical Sections, as well as being a sub-station of the Plant Breeding Section; (b) the Plant Breeding Station at Njoro, which is the headquarters for wheat breeding and much other investigational work on crops and on the maintenance of soil fertility, also conducted on experimental plots at Rongai and Molo in the Nakuru district, thus dealing comprehensively with the widely different climatic conditions obtaining in that district; (c) the Government Experimental Plot, Kitale, the headquarters of the crop and soil fertility investigational work for the Trans Nzoia district, supplemented by experiments of more local application on farms in the district. There are also special stations in Sotik and on Mount Elgon for dealing with the problems of coffee berry disease and Elgon dieback.

Investigations into problems connected with native agriculture are centred (a) at the Bukura Native Agricultural School and on the seed farms of Nyanza Province; (b) at the Scott Agricultural Laboratories, where there is a native agricultural school, and on the seed farms in Central Province; (c) at the Kibarani Experiment Station, which has just been opened up for the elucidation of problems connected with Coast-agriculture, as well as for a seed bulking farm.

H. WOLFE,
Deputy Director (Plant Industry).

COFFEE SECTION

ANNUAL REPORT OF THE SENIOR COFFEE OFFICER

The Senior Coffee Officer proceeded on vacation leave on 19th June, and was away for the remainder of the year. In July, the section was transferred from head office to the Scott Agricultural Laboratories, the change having the advantage of bringing a number of officers connected with work on coffee into closer proximity, and it also enables the Senior Coffee Officer to keep more in touch with the investigational work at the station.

Ten meetings were held in various districts; the main discussions included Bordeaux spraying, shade, pruning, prevention of soil erosion, green manures, and cover crops. Practical demonstrations on pruning and shade regulation were also given.

Permits were issued during the year for the import of 875 lb. of Blue Mountain coffee seed from Jamaica. This seed was imported by planters growing coffee in coffee berry disease areas. As there is evidence to show that this variety is resistant to coffee berry disease, the Department advised planters who wished to grow this variety to obtain the seed direct from Jamaica.

Coffee Planters' Days.

A two-days' meeting was held in July, at which various officers working on coffee problems gave lectures. Addresses were also given by officers and planters from the neighbouring territories. During the afternoon of the first day planters were conducted round the Scott Laboratories' grounds, and officers of the Department demonstrated the object and/or the results of the work in progress.

The second afternoon was spent in visiting a coffee plantation in Kiambu district, and the manager demonstrated the various methods of culture adopted. The meetings were well attended on both days.

Agricultural Shows.

An agricultural show was held at Nakuru, for which exhibits were prepared, and an officer of the section was in attendance.

General.

The drought of 1933 succeeded by a further drought during the year under review considerably reduced the crop, both in quality and quantity.

Many planters carried out pruning as late as June-July and August in 1933, hoping that new wood would be produced for the "long rains" flowering in the early part of 1934. These hopes did not materialize; and it was unnatural to expect the new growth to be sufficiently advanced for flowering in February, March or April. These dry years have upset the cycle of usual flowering, but given normal seasons the usual period of flowering will recur, provided out-of-season pruning is not carried out.

The crop prospects for the coming year are fairly good, if there is adequate rainfall.

*Co-operative Experimental and Investigational Work
with Planters.*

On account of the prolonged drought, observations on manurial trials and mulching in Kikuyu Province were discontinued. In Nandi and Sotik plots of coffee are in process of establishment on the multiple stem system in order to demonstrate to planters in these areas the method of pruning which should be adopted when trees are grown on this system.

Vertical Forking.

Drought conditions have discouraged the planter from carrying out this method of cultivation to any great extent, but where it has been adopted excellent results have been obtained.

*Pruning.**Single Stem System.*

From observations made it would appear that many planters are cutting back their trees too severely, resulting in the trees bearing a crop far in excess of their capacity. It stands to reason that, if quantity is produced and the crop suffers from inadequate rainfall, quality must be affected.

Multiple Stem System.

With very few exceptions this pruning is not regularly and properly carried out, and little or no attention is given to "handling". This system on the whole is a simple operation, based on a definite principle, and to this principle planters

must strictly adhere if success is to be attained. In many cases the system is either neglected or misused by attempting a medley of various systems, so that the eventual result is complete chaos.

Shade.

Shade trials are being continued in various districts, including Sotik, Songhor, Nandi and the Trans Nzoia. The most recent additions to these trials are *Albizzia sasa*, *Enterlobium timbouva*, and *Ruprechtia vivoru*.

Acrocarpus fraxinifolius, mentioned in a previous report, is showing good promise in the Trans Nzoia. Although it has not the canopy characteristics of an ideal shade tree, it has many advantages compared with *Grevillea robusta*; it is quicker growing, and does not appear to compete for moisture with coffee growing in close proximity.

Mororowet.—This semi-permanent and quick-growing tree is becoming very popular in Nandi and Kaimosi. It is also under trial in other districts, but no recent reports on its behaviour are to hand.

Inga vera.—A third attempt has been made to propagate seed of this shade tree of the West Indies and Central America. The seed, which was obtained on this occasion from Amani, failed to germinate.

Trema guineensis (*Muhetha*, Kik.).—This tree is reported upon favourably for shade on Kilimanjaro. Some years ago it was tried in the Kikuyu Province, but found unsatisfactory owing to its competition for moisture with coffee bushes in close proximity. It is now suggested that this tree be given a further trial in some of the wetter districts west of the Rift Valley.

Shade Regulation.

Far too little attention is being given to this matter. If suitable shade trees are established in those districts where it is considered that shade is essential, satisfactory results can only be obtained if the shade is properly regulated. Practical demonstrations on shade regulation have been given from time to time in various districts. An article on shade, including details of the erection of artificial shade, was prepared during the year, and will be published in the *East African Agricultural Journal*.

Bordeaux Spraying.

It was noticed that when spraying was carried out during a period of drought, wilting and collapse of the beans occurred more severely on the sprayed than on the unsprayed bushes, but with the advent of rain the recovery of the sprayed bushes was more rapid. Providing the period of drought is not too prolonged, the sprayed bushes will have more productive wood (as compared with the unsprayed) for the next crop.

From observations to date, it is considered that systematic spraying will influence more uniform and increased yields, which will justify the extra cost of production.

Kitale Experimental Station.

The variety trials and experimental work which are being carried out by Mr. Maher cannot be commented on, as no visit was made during the year under review owing to absence on leave, but the progress of work will be dealt with in the annual report of the Agricultural Officer, Kitale.

REPORT BY MR. S. GILLETT ON INVESTIGATIONAL WORK AT THE SCOTT AGRICULTURAL LABORATORIES.

Rainfall.

The total for the year was 25.33 inches, an increase of 0.47 in. over 1933, but 14.72 in. below the average for the last eight years.

Monthly records were as follows:—

January	...	...	...	0.37 in.
February	...	...	...	1.12 in.
March	...	...	...	1.25 in.
April	...	...	...	3.71 in.
May	...	...	...	8.21 in.
June	...	...	...	2.41 in.
July	...	...	...	0.91 in.
August	...	...	...	0.33 in.
September	...	...	...	0.02 in.
October	...	..	...	2.42 in.
November	...	...	...	1.96 in.
December	...	...	...	2.62 in.

Crop.

The yields of parchment coffee obtained from the several plots were as follows :—

Kents variety, Single Stem : Not yet bearing.

Other varieties, Single Stem : 17.1 cwt. per acre.

All varieties, Multiple Stem : 13.9 cwt. per acre.

Mocha Plot, Plot 23 : 5.9 cwt. per acre.

Odd plots, approx. $3/4$ acres : 12 cwt. per acre.

Average for all bearing coffee, 11.7 cwt. per acre.

Owing to the severe drought conditions which prevailed, considerable quantities of green cherry had to be stripped, and the quality of the prepared coffee obtained was below average.

Comparative Yields of Coffee Grown on the Single and Multiple Stem Systems over a Period of Six Years.

		CWT PER ACRE						
		1929	1930	1931	1932	1933	1934	Average
Single Stem	..	6.8	1.3	4.6	3.8	4.0	17.1	6.26
Multiple Stem	..	9.0	2.0	8.3	5.4	1.0	13.9	6.6

It will thus be seen that over a period of six years the difference in yield between the two systems is almost negligible.

Pruning Investigations.

(a) Monthly Pruning.

A block of coffee (Kent's variety) was set aside at the end of 1933 for observations on the effect of pruning coffee at different months throughout the year. This block is subdivided into twenty-four plots; of these two plots are pruned each month throughout the year. One-half of each plot is sprayed with $\frac{1}{2}$ per cent Bordeaux mixture in March; the other half remains unsprayed. At the time the experiment was laid down the trees were carrying a large amount of whippy wood, and were thus in need of a heavy pruning to restore them to a good condition. The first two plots were pruned in October, 1933, so that the cycle was completed for the first time in September, 1934.

The following observations were made on the plots throughout the year,—

October-pruned Plots.—No flowering on new wood, but very light one on old remaining leader primaries during April rains; moderate flowering on both new wood and old wood during October rains, very advanced heavy spiking noticeable at end of year. Handling was carried out on this plot during March. The second pruning was carried out in October, 1934. This consisted of cutting away all the whippy leaders. It was particularly noticed that there was very little growth in the centre of the tree to be removed.

November-pruned plots.—No flowering occurred during the April rains; medium flowering on both new and old wood during October rains; advanced heavy spiking noticeable at end of year. Handling was carried out on this plot during March. The second pruning was carried out in November, 1934. This again consisted of cutting away all the old whippy leaders and a general combing-out of the new growth. Again very little handling was necessary.

December-pruned Plots.—No flowering during the April rains; a light flowering on both new and old wood in October, but appreciably less than the flowering which occurred on the October and November plots; an advanced moderate spiking at the end of the year. Handling was carried out during March and again during August. The second pruning, which was carried out in December, 1934, was similar to the pruning on the two previous plots. No special observations were recorded.

January-pruned Plots.—No flowering during the April rains; only very slight flowering on new wood during the October rains, but trees in a very healthy condition; an advanced moderate spiking noticeable at the end of the year. Handling was carried out during April and August.

February-pruned Plots.—No flowering on new wood in either the April or the October rains; a very light flowering, however, on old wood during the October rains; an advanced fair spiking at end of year. The young leaves which were exposed after the heavy pruning suffered severely from sun scorch. Handling was carried out during August.

March-pruned Plots.—No flowering occurred on any wood during the April and October rains; an advanced fair spiking at the end of the year. Handling was carried out during October.

April-pruned Plots.—No flowering on any wood during the October rains; a fair spiking, not so advanced as in the previous plots, at the end of the year. Handling was carried out during October.

May-pruned Plots.—No flowering on any wood during the October rains; very little spiking at the end of the year. It was noticed that the new leaves produced were smaller and not so luscious as those on plots pruned during previous months. Handling was carried out during November.

June-pruned Plots.—No flowering on any wood during the October rains; practically no spiking noticeable at end of year. No handling was carried out during the year.

July-pruned Plots.—No flowering on any wood during the October rains; no spiking noticeable on any wood at end of year. No handling carried out during the year.

August-pruned Plots.—No flowering on any wood during the October rains; no spiking noticeable on any wood at end of year. No handling carried out during the year.

September-pruned Plots.—Similar observations as for August.

Conclusions to be drawn from Observations made during the First Year.—1. No flowering can be expected on new wood until it is at least ten months old when trees are grown under conditions similar to those at this station.

2. The time of pruning may thus materially influence the time of flowering. Nevertheless, it must of necessity be several years before any definite opinion can be expressed on the influence of flowering in relation to pruning at various periods; climatic conditions will undoubtedly be important factors.

3. Whilst it was observed that heavy pruning carried out on trees with a dense foliage caused severe sun scorching on the remaining leaves during a period of intense sun, the condition did not appear to cause any noticeably bad effect during the season when the trees made their new growth.

(b) *Methods of Establishing Coffee on the Multiple Stem System.*

One of the most serious drawbacks to this system in districts in which mealy bug is prevalent is the cost of banding. In an attempt to overcome this problem, an experiment has

been laid down to test out different methods of inducing sucker growth at such a distance from the ground as to leave sufficient space on the main stem for banding. It is as yet too early to make any observations.

(c) *Multiple Stem System.*

Extensive observations have been made on the habit of growth of a large number of suckers in the second cycle. Whilst it is too early to give definite conclusions, it would appear that it is preferable on many scores, including that of pest control, to allow the new growth to become moderately whippy. Suckers which were capped owing to their rapid growth have failed to produce the same quantity of crop as the uncapped ones, and although the growth below the "cap" has stiffened up considerably, the new growth has again come away whippy owing to its being drawn up under the shade of more advanced suckers. Therefore little ultimate gain has been obtained. Also it has been observed that trees capped high are very liable to break at the capping point.

Spraying Investigations.

Further spraying observations were again carried out during 1934. Notes made on the different sprayed plots are as follows :—

Plot I.—Control, unsprayed. Heavy crop almost completely breaks down owing to loss of foliage resulting in severe carbohydrate dieback; practically the whole crop had to be stripped in the green cherry stage. Weight of parchment coffee off plot, 46.8 lb.

Plot II.—Sprayed with 1 per cent Carbide-Bordeaux; two sprayings, in March and June. Foliar appearance outstanding, light flowering occurred in October; severe wilting during dry weather, but rapid recovery after a light rain; no dieback of primaries, but breakdown of bean. Weight of parchment coffee off plot, 72.6 lb.

Plot III.—Sprayed with 1 per cent Carbide-Bordeaux; one spraying in March. Condition very similar to Plot II, with the exception that slight dieback of the primaries was noticed and leafage slightly reduced. There was a marked improvement over Plot V, but not so good as Plot IV. Weight of parchment coffee off plot, 74.4 lb.

Plot IV.—Sprayed with $\frac{1}{2}$ per cent Carbide-Bordeaux; two sprayings in March and June. This plot was almost comparable with Plot II. Severe wilting was again noticed, but

there was practically no dieback of the primaries. Weight of parchment coffee off plot, 83 lb.

Plot V.—Sprayed with $\frac{1}{2}$ per cent Carbide-Bordeaux; one spraying in March. Whilst the condition of this plot over the unsprayed plot was most marked, it did not compare at the end of the season with the other sprayed plots. Although the actual crop picked off it was slightly higher, dieback was more noticeable and the trees were not left in such a healthy condition. Weight of parchment coffee off plot, 83.8 lb.

Plot VI.—Sprayed with $\frac{1}{2}$ per cent Burgundy Mixture; one spraying in March. Although this plot bore the heaviest crop, the leafage was comparable to the $\frac{1}{2}$ per cent one spray Carbide-Bordeaux mixture. Weight of parchment coffee off plot, 107.8 lb.

Conclusions.

1. Although sprayed trees appeared to wilt very severely during the dry weather, recovery after a light rain was most rapid, and no dieback of the primaries occurred.

2. The sprayed plots at the end of the season were in good condition, and spiking for the coming season's crop was evident. In contrast, there is little possibility of a crop being obtained from the unsprayed plot.

3. As regards the time of spraying and the strength of the spray used, the following observations are worthy of note :—

(a) Whilst it is contrary to observations previously made on plantations and at this station, the plots sprayed with 1 per cent solution during the year under review appeared preferable to those sprayed with $\frac{1}{2}$ per cent solution. It must, however, be noted that conditions throughout the year were quite abnormal, and consequently the observations should be treated with reserve.

(b) That spraying in the months of March and June with a $\frac{1}{2}$ per cent solution is preferable to spraying only in March with 1 per cent solution.

(c) That spraying in March and June with either 1 per cent or $\frac{1}{2}$ per cent solution is preferable to only one spray applied in March.

(d) From observations made on the sprayed and unsprayed portions of the monthly pruning experiment it would appear that in order to prevent leaf-fall occurring during July and

August one spraying must be applied during the month of March or April. Foliage which is produced after this date would not appear to become infected, and consequently fall, during that season. If spraying is carried out earlier than March and no subsequent spraying applied, the foliage produced between the time of spraying and March may be sufficiently mature to become infected.

(e) Over a period of one year, the results obtained from the use of Burgundy mixture would appear to be comparable with those of Carbide-Bordeaux.

Mulching Observations.

The following plots were under observations during the year :—

- (a) Seven-year-old coffee mulched for three successive years.
- (b) Five-year-old coffee mulched at termination of rainy season, June, 1934.
- (c) Young seedlings planted out during the April rains, 1934, and mulched immediately after planting.

As regards (a) and (b), an interesting factor arose. Owing to the severe drought conditions which prevailed during 1933 and the poor rains which fell during April, 1934, it would appear that the ground was so reduced in moisture content before the application of the new mulch in June, 1934, that no appreciable conservation was possible. In both plots the crop broke down as badly as it did in the control plots, which were soil mulched. Samples of coffee from the mulched and unmulched plots were subjected to a liquoring test in Nairobi, when it was found that the quality off the mulched plot was slightly better than from the unmulched. This was most noticeable as regards acidity. The total points awarded the mulched coffee were 22 as compared with $15\frac{1}{2}$ from the unmulched.

In the case of (c), it would appear that the mulch applied did not materially assist the young seedlings to withstand the subsequent drought conditions. Both the unmulched and mulched plots suffered equally.

Mulching Material.—As Napier grass is being widely grown for mulching material, the following figures obtained here will be of interest. A cutting of Napier grass was made when the grass was about 3 ft. 6 in. to 4 ft. high, and gave approximately 7 tons of green material per acre. These 7 tons

were found to be sufficient to mulch an area of approximately one-fifth of an acre of coffee. It may be reckoned that four cuttings of Napier grass can be made per year, so that one acre is sufficient to mulch four-fifths of an acre of coffee.

Shading Observations.

The erection and subsequent trial of a heavy canopy of artificial shade was found some years ago to reduce considerably the cropping capacity of the tree, but to improve its general health and vigour. As a result the canopy has been reduced, with apparent beneficial effect. It would appear from the results obtained and stated below that shading may still prove to be an extremely important factor controlling quality of the bean.

Samples from shaded and unshaded trees were subjected to a liquoring test in Nairobi, and the following results were obtained: Shade coffee, 20½ points; unshaded coffee, 14½ points.

The liquorer reported that, whilst both samples were very lacking in acidity, the appearance both in the raw and the roast of the shaded coffee was infinitely better than the unshaded.

Root Growth and Root Systems of Coffee Trees : Investigations.

Owing to the continued drought conditions which persisted throughout the year under review, this work has of necessity had to be held over.

Coffee Varieties, Tree Selections, Vegetative Propagation and Breeding.

(1) *Varieties.*

“Harar” again is worthy of special mention. The trees have stood up to drought conditions in a remarkable manner, and have produced a good crop. The report of the liquorer received on this coffee has been most satisfactory, and it is now felt that it is safe for seed distribution to be made. Very little seed is available as yet.

The selection of varieties being grown on the farm has been increased during the year by the addition of the following :—

- (a) *C. arabica*, Kent's; seeds from selected trees of 4th and 5th generation! 90 per cent true to type guaranteed; imported direct from Mysore, India.

- (b) Indigenous coffee from the *Institute Nationale pour Etude Agronomique de Congo Belge*.
- (c) *C. arabica*, Blue Mountain; imported direct from Jamaica.
- (d) *C. arabica*, var. *Mocha*; seed from Amani; Puerto Rico, Java; named by Dr. Cramer.
- (e) Hybrid, Bogor Prada; imported direct from Government Coffee Estate, Java.
- (f) *C. robusta*, Bangelan 124-01; imported direct from Government Coffee Estate, Java.
- (g) *Belauan Pasoemah* No. 5; imported direct from Government Coffee Estate, Java.
- (h) *Belauan Pasoemah* No. 11; imported direct from Government Coffee Estate, Java.
- (i) *C. arabica*, *Sumatra*, CS 50; seed from Amani.
- (j) *C. arabica*, *Sumatra*, CS 51; seed from Amani.
- (k) *C. arabica*, var. *Erecta*; seed from Amani.

(2) Tree Selections.

A number of outstanding trees both at this station and on neighbouring plantations have been recorded during the year, and observations are being made. Observations on previous selections are being continued and monoclones are being raised of some of the most promising. These trees are also being multiplied from seed and further selections made.

(3) Vegetative Propagation.

Considerable progress has been made during the year. Grafting presents few difficulties, but much is still to be learned about the propagation of cuttings. A full résumé of all the work conducted may be found in my recent publication on "The Vegetative Propagation of Coffee."

Field work during the year has consisted of planting up plots of Series A, grafted on to different stocks. The following have been planted :—

Series A on *C. arabica*, var. *Columnaris*.

Series A on *C. arabica*, var. *Blue Mountain*.

Series A on *C. robusta*, var. *Kanaka*, Kinawa No. 9.

Series A on *C. arabica*, var. *Maragogipe*.

Series A on *C. arabica*, var. Series E (Jackson's Selection).

Series A on *C. arabica*, var. Series J.

Series A on *C. arabica* hybrid (Red Leaf).

Series A on *C. eugenoides*.

In addition, monoclonés of Harar, Series E, and Red Leaf selections are being multiplied.

A large number of grafts have been made in the nursery and await planting out.

New propagators were erected during the year, and many hundreds of cuttings were used for experimentation. The type of cutting required has, it is believed, been ascertained, but as yet attempts to promote this type of wood in the field have failed.

(4) *Breeding.*

(a) Thirty plants, consisting of five *Arabica* selections made by the Geneticist, East African Agricultural Research Station, Amani, were received from Amani during the year and planted out for observation.

(b) Selfing of selected trees has been continued. The Series A (Kenya Selected) is now ready for selection and selfing in the second generation.

(c) With the object of obtaining possible hybrids of merit, the following crosses were made during the year :—

C. eugenoides x *C. arabica* v. Harar.

C. eugenoides x *C. arabica* v. Mocha.

C. eugenoides x *C. arabica* v. Mysore.

C. arabica v. Mysore x *C. arabica* v. Mocha.

C. arabica v. Mocha x *C. arabica* v. Harar.

C. arabica v. Mocha x *C. arabica* v. Blue Mountain.

Indigenous coffee, Iringa x *C. arabica* v. Harar.

Cover Crop Investigation.

The year offered exceptional opportunities for studying the effect of a cover crop on the coffee tree. A number of soil moisture tests were carried out by the Chemical Section, and in all cases the soil moisture under a cover crop was found to be less than that under an open soil mulch. This was to be expected, but the results must not prejudice planters against the use of these crops. Many other factors must be taken into consideration, especially that of soil erosion, and attempts must be made to establish a cover crop which can be controlled during the dry weather in order to prevent excessive

transpiration. Besides, the humus addition to the soil from a cover crop would increase the plant nutrients, thus decreasing the water requirements of the coffee tree.

Amongst the crops tested out with this object in view the following appear worthy of special mention :—

(1) *Medicago sativa* (Lucerne).—Of the lucernes, the Cossack lucerne would appear most suited. This crop can be easily controlled by slashing with a *panga* immediately the dry weather sets in, and using the cut material either as a mulching crop or to be incorporated in the soil as a green manure. Immediately rain falls again the lucerne will make fresh growth and thus prevent soil wash. The great advantage of this crop is that growth remains near the ground or erect, and has no climbing tendency.

(2) *Glycine javanica*.—This crop can be treated in exactly the same way as the lucernes. The disadvantage of this crop, however, is that its growth, which is of a climbing nature, is very rapid and unless controlled frequently may get out of hand.

(3) *Coronilla varia*.—A low-growing leguminous crop, which rapidly spreads and makes a complete cover over the soil. It may be dug up with fork *jembies* during the dry weather and will again establish itself at the commencement of the rains. A possible disadvantage of this crop is that if neglected it may very easily become a “weed”.

The difficulty with a number of other crops, which form a suitable soil cover, is that they cannot be controlled by slashing or digging in until they have seeded. Amongst these are crops such as—

- (a) *Mucuna utilis*.
- (b) *Calopogonium orthocarpus*.
- (c) *Calopogonium mucunoides*.
- (d) *Phaseolus lunatus*.

Indigofera tettensis produces a useful cover, but is difficult to establish, and it is doubtful whether it could stand plantation conditions.

Green Manure Investigations.

No new green manures of note have been grown. The most suitable for these conditions are :—

- (a) *Dolichos lablab* (Njahi).
- (b) *Lathyrus sativus* (New Zealand Grass Pea).

(c) *Pisum sativum* (Field Pea).

(d) *Phaseolus lunatus* (Mixed Beans).

Shade Tree Investigations.

Of the established trees on the farm it would appear that *Milletia oblata* is the best shade for coffee. *Acrocarpus fraxinifolius* is not producing shading qualities, but would appear to be an excellent substitute for *Grevillea robusta* as a shelter belt or windbreak, etc. During the recent dry years it has been clearly noted that coffee which has wilted badly under *Grevillea* has stood up to the conditions remarkably well under *Acrocarpus*. A number of new trees have been introduced for trial during the year. The following is a complete list of all varieties on the farm.

1. *Gliricidia maculata*.
2. *Milletia oblata*.
3. *Dalbergia assamica*.
4. *Grevillea robusta*.
5. *Ficus* sp.
6. *Cordia holstii*.
7. *Machaerium tipu*.
8. *Acrocarpus fraxinifolius*.
9. *Albizzia lophanta*.
10. *Maesopsis birchemoides*.
11. *Commiphora Mukinguku*.
12. *Ruprechtia vivoru*.
13. *Enterolobium timbouva*.
14. *Albizzia sasa*.
15. *Colpurnia aurea*.
16. *Vernonia amygdalinas*.

Factory Tests.

Working in close co-operation with the Bio-Chemist of the Coffee Board, a large number of fermentation and drying experiments were carried out in the factory during the picking season. A full report on the result of these tests is being published, so that reference need not be made to them at this juncture.

ARTHUR TRENCH,
Senior Coffee Officer.

ENTOMOLOGICAL SECTION

ANNUAL REPORT

Mr. Anderson went on leave, pending retirement, on 28th July, after 26 years with the Department.

Mr. Wilkinson was seconded during the whole year to the Coffee Berry Disease investigations at Sotik.

Dr. Le Pelley was offered a Commonwealth Fellowship, and left on the 28th July to pursue studies in the United States of America for a period of two years. Previous to this date he was stationed at Kasarini engaged in research work on Antestia.

Mr. Notley returned from leave on 9th July, and after spending a few days at the Coast in connection with locust experiments, was stationed at the Scott Laboratories for the remainder of the year.

Mr. Naismith Jones was stationed at Kasarini with Dr. Le Pelley. After the latter's departure, Mr. Naismith Jones continued the work on Antestia on the lines laid down. This work remains under the direction of Dr. Le Pelley by means of air mail reports.

Mr. C. D. Knight remained in Nyanza Province, engaged in inspection work, until the end of September, when he was transferred to the Scott Laboratories for the remainder of the year.

Mr. Cottingham was seconded to the Coffee Berry Disease investigations at Sotik until he went on leave on 26th May on medical grounds. He did not return during the year.

Mr. Cooper was engaged in inspection work in the Trans Nzoia and Uasin Gishu districts, chiefly on the campaign against neglected plantations, until May, when he was seconded to Sotik to relieve Mr. Cottingham.

209 Import Permits and 152 Certificates of Examination were issued during the year.

Review of the Year.

Work has continued mainly on coffee pests. Mealybug caused, if anything, rather less damage than in previous years, but this may be due to the fact that it did not spread to any new coffee areas, and to the increasing practice of banding

in areas where mealybug is present, rather than to a lessened severity in the attack of this pest. A number of cases were recorded where mealybug which had broken out early in the year refused to clear up despite banding: the reasons for this are not clear. Antestia was still a very serious pest during the year, but during the last three months of the year a general fall in their numbers was noted. Capsid gave practically no trouble during the year.

The failure of the short rains following on a shortage of rain in the previous year, seemed to cause an increase in the number of borers in coffee. White borer, *Anthores leuconotus*, continued to give trouble in the Makuyu-Ithanga district, whilst Yellow-headed borer was recorded from various localities, but caused little damage. *Phloeobius* was recorded again from Maragua and Subukia, the former record being a single one and the latter a recurrence of an outbreak on one farm last year.

An outbreak of cherry-fall occurred in the Kiambu area during June. Fallen cherries showed signs of having been attacked by a small fly. From large collections of these attacked cherries only five pupæ were obtained, of which only two completed their development and emerged as flies. They proved to be the fruit-fly, *Ceratatis capitata*, which normally only oviposits in ripe cherry. It is supposed that unfavourable climatic conditions resulted in a condition of the cherry which induced oviposition by the adult flies, but that the cherry was not in a condition for the full development of the resultant larvæ.

Legislation.

During the year the Central Province was made a closed area with a view to the prevention of the spread of mealybug to coffee-growing areas west of this area. No plants of any sort, or parts of plants except seeds, may now be taken out of the Central Province to the west except under permit from the Department after examination. Certain accredited nurseries, however, are examined once a fortnight and these nurseries may send plants out of the Central Province after treatment and examination.

Nyanza Province was also declared a closed area for the prevention of the spread of *Stephanoderes*; no coffee may leave Nyanza Province except in new bags, and these bags may thereafter only be used for the export of goods from the country, or destroyed, unless first treated to the satisfaction of the Department.

During the latter half of the year it was found that no guarantee could be given of the moisture content of certain foreign coffees, and thus their freedom from live *Stephanoderes*. The 1934 coffee rules which had been drafted with the object of allowing such coffee to circulate on the Nairobi market were amended. The new coffee rules (1935) were devised to tighten up the regulations regarding the movement of coffee from areas where *Stephanoderes* is known to exist, including such areas in Kenya itself, to safeguard the large coffee growing areas from which *Stephanoderes* has apparently been successfully eliminated.

In accordance with the recommendations of the conference on the co-ordination of research and plant protection held in Amani in February, and attended by Mr. Anderson and Dr. Le Pelley, the Diseases of Plants Prevention Ordinance and Rules have been redrafted in collaboration with the Senior Mycologist, for discussion by all the East African territories with a view to the ultimate adoption of identical regulations by them all. The object of this is to ensure that no country will be endangered by its neighbour importing material which, whilst it may not endanger the importing country's crops, might endanger crops in another country.

The Coastal area was made a closed area for cotton seed to prevent the spread of Pink Boll Worm from this area, which is endemic, to areas in the Central Province and Nyanza Province where Pink Boll Worm has not been found, and where large-scale development of the cotton crop is contemplated.

Stalk-borer of maize having increased considerably during the last few years, arrangements were made to reinforce the Stalk-borer regulations in 1935. The increase may be ascribed to the relaxation of these rules which has been made necessary both by shortage of staff and by the depredations of locusts.

Research Work.

Research on the bionomics of *Antestia* and on the control of this pest has been continued at Kasarini Field Station. A separate report by Dr. Le Pelley on this work will be found below.

During his studies in America Dr. Le Pelley has been pursuing ecological work on a *Pentatomid* bug and on a mealy-bug. This experience thus gained should be of considerable value to this country on his return.

Whilst on leave in England Mr. Notley worked at the University of Birmingham on a physiological problem, using locusts as material. On his return from leave this type of work was applied to the mealybug problem, and gives promise of some interesting results.

It was decided some time ago that the most profitable line of work for the control of mealybug lies in the introduction of internal parasites. Taxonomic work by Dr. James has established that our epidemic form of mealybug is probably indigenous to the East Indian Archipelago and that the most likely place to look for internal parasites is in this area. Unfortunately at present the financial state of the country does not allow for a search of this area to be made. There are two possibilities however which can profitably be explored before embarking upon this more expensive project. One is the introduction of parasites of various species of *Pseudococcus* from any place where these are easily obtainable. Through the courtesy of Dr. Thompson of the Parasite Breeding Station at Farnham Royal, England, and Professor Smith of California, the first of these introductions was made, consisting of a consignment of *Coccophagus gurneyi*, *Leptomastix abnormis*, and a *Hyperaspis* sp., the first two parasites and the third a predator of *Pseudococcus gahani*, the Citrophilus mealybug. Only the first arrived alive, and about thirty adults were obtained. Mating and oviposition in *P. lilacinus* took place, but no adults of the parasites emerged from parasitized mealybugs. This was not unexpected, since though *C. gurneyi* has proved a most effective parasite of the Citrophilus mealybug in California, most of these internal parasites of mealybug are very specific in their habits, and whilst they may not distinguish between species of mealybug for purposes of oviposition, the eggs which are laid in the wrong species usually find conditions totally unsuitable for development. In other words, a mealybug is strongly resistant to parasites which are not its normal parasites.

These introductions of parasites of mealybugs other than *P. lilacinus* may therefore be regarded purely as shots in the dark, and rather unlikely to succeed. Further introductions however are to be made.

Meanwhile every effort is being made to get into touch with places where *P. lilacinus* has been recorded. The difficulty is that in no country except Kenya has *P. lilacinus* been recorded as a pest, and therefore practically nothing is known of the insect or its parasites outside Kenya.

The second possibility to be explored is that of specific parasites being present in Bukoba or Uganda. *P. lilacinus* has been recorded from various places there, and in some places attended by *Pheidole punctulata*, but is not a serious pest. There is a remote possibility that this is not due to an unsuitable climate there, but is due to the presence of parasites. It may be that *P. lilacinus* was introduced to areas west of the Lake (it is probably not indigenous there), together with effective parasites which are not present in Kenya. Mr. Ritchie, Entomologist to the Tanganyika Department, is spending several months in the Bukoba District early in 1935, and has kindly offered to investigate this point. Allied with this is an investigation under laboratory conditions of the climatic requirements of *P. lilacinus* at the Scott Laboratories in an attempt to explain the discontinuous distribution of *P. lilacinus* in East Africa, the reason for its epidemic status in the Central Province of Kenya but absence elsewhere, and if possible to find out the limits of its possible distribution and the reason, if climatic, for its harmlessness in Bukoba and Uganda. During December, apparatus was devised and built to investigate this point.

Insecticides.

The investigation into methods of evaluating biologically the toxicity of pyrethrum was continued during the latter half of the year. Various methods were tested critically, but as yet no method has been found which will give dependable results. This work is continuing.

Considerable work was done on a substance which was submitted by a Kenya settler as a spray for locust work. After preliminary trials in Nairobi, a field test was carried out at the Coast which was attended by Mr. H. B. Johnston, of the Imperial Advisory Committee on Locust Control, the Chief Locust Officer, and Mr. Notley. These trials were not considered to have given satisfactory results, and further laboratory tests which were carried out in Nairobi confirmed this finding. Later the inventor produced an improved spray, which proved to be superior to the previous one in laboratory tests. A flying swarm having been located near Ngong, a field test was carried out, but the results were inconclusive. Further field tests were postponed until locust hoppers were available, since the results of tests on flying locusts, owing to their mobility, are extremely difficult to interpret.

Publications.

Bulletins :

No. 5.—Report on Questionnaire on Antestia Control, 1933-34, Dr. R. H. Le Pelley.

No. 8.—Pyrethrum Extract Spraying for the Control of Antestia on Coffee, Dr. R. H. Le Pelley.

Leaflets :

No. 2.—Preparation and Application of Sodium-Arsenite Poison Bait against Antestia, Dr. R. H. Le Pelley.

No. 3.—The Dusty Brown Beetle, *Dasus (Gonocephalum) simplex*, F. B. Notley.

No. 4.—Stalk Borer of Maize.

No. 5.—Storage of Grain.

In the Press :

Leaf-eating Caterpillar of Coffee, *Metadrepama andersoni* Tams., F. B. Notley.

DR. R. H. LE PELLEY'S REPORT.

During the year experimental work continued at the field laboratory on Kasarini Estate, Kiambu, and on coffee plantations in the district. The continued investigation of Antestia bionomics, begun in 1933, formed the major portion of the work. Observations on *Lygus*, leaf-miner moth, and other coffee feeding insects were also made.

At the Agricultural Research and Plant Protection Conference at Amani in February, 1934, it was decided that in order to avoid duplication of work certain major projects should be undertaken by a single department. It was decided that work on the bionomics and ecology of Antestia, which was already in progress in Kenya, should be continued under the writer's direction. Work on the control of the insect would of course be carried out wherever necessary.

The bionomical work was continued during the year, with the co-operation of a number of planters who set aside small blocks of coffee on which regular observations could be made, and who refrained from disturbing the Antestia on those blocks as long as this was consistent with the safety of the remainder. It may be pointed out, however, that until coffee is available on which Antestia can be allowed to remain completely undisturbed, results will only be obtained slowly and with difficulty. The work has entailed regular monthly test sprayings, and collection and examination of Antestia eggs.

By the end of the year more than 125,000 eggs had been examined. A number of other aspects of *Antestia* bionomics were studied in the laboratory and field.

In addition, considerable investigation of the available control measures was undertaken, and valuable indications were obtained, although certain of the work remained uncompleted. It was shown conclusively that hand-picking is not a method of value for the control of *Antestia*, and considerable sums are annually wasted on this measure. Work on the poison-bait method was not concluded. On the pyrethrum-extract spraying method work was chiefly directed to improving the methods of field application. A number of planters made material contributions in this direction. A departmental bulletin was published on the subject.

With the object of collecting information on the different control methods used by planters against this insect, a questionnaire was circulated to coffee planters. The results were published in a departmental bulletin.

A visit was made by the writer to Sotik in May to study the *Antestia* and *Lygus* position and to advise on the control of these insects. A report covering this investigation was prepared.

A paper giving the recent conclusions of the work on the control of *Antestia* was read at the Planters' Day Meeting in July, and a field demonstration was given at the Scott Agricultural Laboratories.

The writer left the Colony for the United States in July to work on entomological subjects of importance to Kenya and to study the entomological work and methods of the United States Department of Agriculture.

In his absence the field station at Kasarini was maintained and was in charge of Mr. H. Naismith Jones, who continued the routine of the investigations on lines laid down. In addition to the normal meteorological work of the station, observations were made for the Director of the B.E.A. Meteorological Service in experiments on the influence of certain climatic factors in coffee-growing.

BOTANICAL SECTION**ANNUAL REPORT OF THE SENIOR MYCOLOGIST****STAFF.**

As heretofore, my headquarters have been at the Scott Agricultural Laboratories. Until he proceeded on leave, Mr. Thorold continued to be stationed at Njoro, but on his return he was transferred to Mount Elgon, primarily to carry out investigations on the coffee disease known locally as Elgon dieback. His other duties include work on coffee berry disease, supplementing that in progress in Sotik, and collaboration with the Agricultural Officer, Kitale, on the mycological side of the latter's maize-breeding activities. During the year Mr. D. C. Edwards' headquarters was moved from the Scott Agricultural Laboratories to the Veterinary Research Laboratories, where better conditions and facilities for his pasture investigational work are available.

PUBLICATIONS.

By Myself :

" Notes on Coffee Anthracnose (Elgon Dieback)." — Address at Coffee Planters' Days, published as Press article.

By Mr. Thorold :

" Production of an Artificial Epidemic of Wheat Stem Rust in Kenya Colony." — Annals of Applied Biology, XXI, 4, November, 1934.

By Mr. Edwards :

" Rhodes Grass for Pasture and Hay." — Department of Agriculture Bulletin.

CONFERENCES, LECTURES, SHOWS, AND FARMERS' DAYS.

Immediately on my return from leave in February, I proceeded to the East African Agricultural Research Station, Amani, Tanganyika Territory, where I attended the Conference on Co-ordination of Agricultural Research and Plant Protection.

During his leave in England, Mr. Thorold attended the meetings of the Third Imperial Mycological Conference held at the Imperial College, South Kensington, from 17th to 22nd September. At the session devoted to foot-rot of cereals, he read a paper on their occurrence in Kenya.

I attended the Coffee Planters' Days in July and gave addresses on coffee anthracnose and berry disease. I also addressed meetings of the Songhor Farmers' Association and Nandi Planters' Association respectively, on coffee diseases, in August.

At the Nakuru Show in December Mr. Edwards and I staged exhibits relating to grassland improvement and mycology respectively.

INVESTIGATIONAL WORK.

As in previous years, Mr. Edwards will submit a separate report on his work on pasture problems.

Coffee.

Berry Disease.

Field work on the Coffee Berry Disease Experimental Station in Sotik has been under the local direction of Mr. H. Wilkinson, seconded from the Entomological Section, throughout the year.

Mr. Cottington, Plant Inspector, who assisted him during the earlier months, had unfortunately to be sent to England on sick leave. From March onwards, however, he was replaced by Mr. A. J. Cooper, Plant Inspector, who continued to be stationed in Sotik during the remainder of the year. As a complete account of the work on the Experimental Station has been published in the Coffee Board Bulletin, only a summary need be given here.

The principal aims of the work on the plots have been—

(a) to discover the best ways of building up plantations resistant to berry disease or of converting existing susceptible plantations into resistant ones by means of vegetative propagation,

(b) the discovery of palliative measures to assist in tiding over the period until resistant plantations can be established, and

(c) to carry out experiments of various kinds designed to gain additional knowledge of the factors involved in the incidence of berry disease.

The problem of building up resistant plantations divides itself naturally into two parts, namely, the establishment of new plantations and the conversion of old susceptible plantations into resistant ones. As the result of continuous observations extending over several years, some fairly definite advice

can now be given in respect of new plantings in Sotik, and it is believed that the same recommendations will apply to a considerable degree in other districts subject to coffee berry disease. The so-called French Mission coffee should not in future be planted in areas where conditions favour coffee berry disease. French Mission coffee consists of a mixture of many types, most of which possess very little resistance to berry disease, and are consequently liable to suffer severe loss of crop when subjected to infection. On the other hand, four years of close observation of the Blue Mountain variety, growing in Sotik side by side with French Mission coffee of the same age and history, have shown markedly superior resistance to the disease, amounting almost to immunity in the former. In spite of a single reported instance of an appreciable amount of berry disease in Blue Mountain coffee in another district, a considerable distance away, this variety is regarded as the safest to plant from the point of view of resistance to berry disease. For various reasons it has not yet been possible to examine scientifically the circumstances connected with the reported appearance of berry disease in Blue Mountain coffee mentioned above, but it is hoped to do so in 1935. It may be mentioned, however, that the infection recorded was one of ten per cent compared with fifty per cent in French Mission coffee on the same estate. It may also be stated that elsewhere in the same district the Blue Mountain variety is regarded as resistant to the disease. The only other variety on which it has been possible to carry out at all extensive observations on resistance to berry disease is Mysore. The evidence in respect of this variety is somewhat conflicting, but this is probably due to the fact that most of the plantations of Mysore coffee in areas subject to berry disease are not from directly imported seed and consequently contain a percentage of individuals which are not true to type. My own opinion is that the true Mysore coffee will be found to be resistant to berry disease.

Individual resistant trees undoubtedly exist amongst the French Mission plantations, but they are comparatively rare. On the eight acres of bearing coffee on the Sotik plots, for instance, Mr. Wilkinson, after two years' observations, does not consider that there is a single tree sufficiently resistant for selection work. Experiments have nevertheless been carried out to test the possibilities of obtaining vegetative propagation of material from individual trees under Sotik conditions. Numerous attempts to obtain cuttings have failed, however, and this method is now considered unsuited to the district.

On the other hand, good root development has been consistently obtained on suckers by the "etiolation" method, while still attached to the parent tree, and these merely await the arrival of favourable weather conditions to permit of their being detached and planted out for trial.

A considerable range of varieties of coffee is being grown at the Sotik plots for resistance trials on their own roots and in various combinations as scion or rootstock, to be obtained by grafting or inarching. Sub-stations for observations on varietal resistance exist on farms on the Nandi Escarpment and Mount Elgon.

The conversion of old susceptible plantations into resistant ones may prove a complicated matter. Mr. Cottingham has shown that it is possible to obtain a high percentage of successful grafts on old Mocha rootstocks, but it remains to be seen whether scions of resistant varieties will retain their resistant qualities on old rootstocks of susceptible varieties.

Elgon Dieback.

I made a special visit to Mount Elgon in June in order to continue investigations begun by Mr. Thorold. At the time of my visit the disease was in an active state and, through the courtesy of Mr. T. H. E. Jackson, who provided the necessary accommodation, I was able to make numerous artificial cultures from diseased tissues.

The disease affects branches and suckers, and nearly always begins at a point distant from the tip, generally at a node. It spreads up and down the affected shoot until all the tissues for a considerable distance from the tip backwards are dead, at which stage the trouble is indistinguishable from common dieback.

The principal outbreaks both in 1933 and 1934 occurred following heavy rain in May after a previous prolonged period of drought. Severe attacks were confined to altitudes of about 6,500 feet and over, and seemed to be closely associated with the production of the small, yellow, crinkled type of foliage. The trouble appeared to be alleviated by shading or heavy mulching.

Among the fungi isolated from various kinds of diseased tissues, several species or strains of *Phoma* preponderated. *Colletotrichum*, so common on dead coffee tissues in other parts of the country, occurred occasionally only.

On his return from leave, Mr. Thorold was stationed on Mount Elgon in order to specialize on the investigation of the dieback disease, which is said to be on the increase and is causing some alarm among coffee-growers in the area.

Wheat.

Stem Rust.

I had the assistance of Messrs. Evans and Gamble in producing an artificial epidemic of stem rust in the Plant Breeding Section's plots at the Scott Agricultural Laboratories, Nairobi. The object of this work was to subject a large number of new hybrid selections and a few other wheats to simultaneous infection with all the four physiologic forms of stem rust known to occur in Kenya, and thus to test their rust-resistant qualities.

The wheats to be tested were planted in 76 plots, each 66 feet long by 2 feet wide, arranged parallel to one another in pairs, and with a pathway 3 feet wide between each two pairs. In these pathways, on either side of the pairs of plots, a "surround" row of Reward wheat was sown at about the same time as the wheats in the plots. It would have been preferable to have sown these surround rows about a fortnight before the plots to be tested, but weather conditions prevented this. Reward wheat was chosen on account of its high susceptibility to all the four Kenya forms of stem rust, and its suitability therefore for artificial inoculation with these forms to provide starting points for subsequent spread by natural means to the selections under test in the plots.

The surround rows of Reward wheat were planted on 20th April. Artificial inoculation of the surrounds was begun on 7th May, and continued at intervals until 1st June, by which time 203 infection points, well distributed among the plots, had been established. Each infection point consisted of about six seedling leaves, which were inoculated by means of a flat needle from stock cultures of one or other of the forms which had been worked up in advance for the purpose. Immediately after inoculation, each group of leaves was covered by a bell jar for 48 hours, and was marked with a wooden label which showed which physiologic form had been used. This made it possible to determine by subsequent inspection the degree of success attained in establishing infection in the surround with each form. After 1st June the plants were too large to be accommodated conveniently under the bell jars

used, and this method was then discontinued. The number of infection points thus established with each form was as follows :—

Form K1	...	...	...	44
Form K2	...	...	...	38
Form K3	...	...	...	38
Form K4	...	...	...	83
Total				203

Observations showed that Forms K1, K2 and K4 soon became well established in the surrounds, but K3, although present wherever inoculation with it had been carried out, was considerably less vigorous.

By 5th June the plants in the surround had reached the piping stage, and averaged about 18 inches high. On this and the three succeeding days a second method of inoculation was employed, in which a suspension of rust spores in water was injected by means of a hypodermic syringe into a point near the tops of the growing stems. About fifty plants per row were thus injected in four surround rows towards the windward side of the plots, a different form being used in each row.

One month after injection heavy infection was found to have occurred on all injected plants. Large pustules developed on stems and leaves, the rust attack being so conspicuous as to enable injected plants to be picked out from their neighbours at a distance without reference to the labels. The infection was particularly severe with Forms K1 and K2 which produced considerable rust on the ears.

Frequent observations were made for the appearance of rust in the tests plots. When these were originally planted, a few rows of Kenya Governor, Kenya Standard, Vernal, Reliance and Einkorn wheats, whose reactions to the various forms were already well known, were sown here and there among them to act as indicators of the spread of particular forms from the inoculated surround rows into the plots under test. By observations on these and by taking rust samples at intervals for laboratory tests, it was possible to follow closely the incidence of the various forms throughout the season.

Stem rust was first noted in the plots on the 5th June, and proved to be Form K4. This observation and subsequent

laboratory tests of samples taken at different times showed the presence of the various forms as follows :—

Date of taking sample			Form found to be present
5-6-34	..	..	K4
22-6-34	..	..	K4
6-7-34	..	..	K4
11-7-34	..	..	K3
14-7-34	..	..	K1
17-7-34	..	..	K1
31-7-34	..	..	K2 and K3
4-8-34	..	..	K2
14-8-34	..	..	K2
18-8-34	..	..	K2

Samples taken in wheat growing some distance from the test plots and to windward of them indicated that Form K4 was the one naturally prevalent in the district during the season. It is reasonably certain that the other three forms occurred in the test plots as the direct result of their artificial introduction into the surrounds.

Conditions early in the season appear to have favoured infection by Form K4. Later, Forms K1 and K3 became noticeable, although there seemed reason to believe that the latter was at no time very vigorous. In the late stages, Form K2 was very prevalent. It thus made its appearance at about the coolest period of the year, a fact which is in keeping with the previously established reputation of this form for prevalence in the higher, cooler parts of the country.

As in former years, tests to determine the rust forms present in various districts or to discover the presence of any hitherto unrecorded form were made whenever possible. No new form was found, but the distribution of those already known in Kenya was as follows :—

Form	District	Month	Form	District	Month
K1	Nakuru ..	September	K4	Nairobi ..	February
K2	Molo ..	January		Nairobi ..	July
	Mau Summit	January		Rongai ..	September
	Mau Summit	June		Nakuru ..	September
				Elmenteita	September
K3	Kipkabus ..	November		Njoro ..	October
				Eldoret ..	November
				Sergoit ..	November
				Nabkoi ..	November
				Kipkabus ..	November
				Molo ..	December
				Elgon ..	December

Three stem rust samples from the Belgian Congo, obtained in January, all proved to be Form K1.

New Disease of Wheat.

What appear to be two different manifestations of a new disease of wheat grains were encountered during the year. It is quite impossible to judge yet of the importance of the discovery, but the degree of infection so far observed in the field has been quite small.

The first sample examined was not direct from the field, but consisted of a very few grains of Burbank wheat, submitted for examination by Messrs. Unga Ltd. in June. The specimens had a scorched or charred appearance, and showed the presence of a jet-black layer immediately beneath the surface. This on closer examination was found to consist of very dark-coloured fungus threads. It proved a simple matter to develop the fungus in artificial culture. Under such conditions the initial growth of the fungus was white, but a dark green colour, eventually becoming almost black, developed in that part of the mycelium which grew within the medium.

In September, Mr. Gamble, of the laboratory field staff, submitted for examination a number of wheat grains which he had encountered while threshing out a hybrid selection, No. 73.D.2.I.2.(L), which had recently been harvested. These grains were shrivelled and pale-coloured, often greenish or greenish-white in appearance, and bore on their surface, especially in the "crease", more or less of a pure white fungus growth. This fungus was also readily obtained in artificial culture, and showed the same growth characteristics as those from the "charred" grains mentioned above.

The identity of the fungus has not yet been established, but it seems highly probable that the disease is new to science. Its investigation is being continued.

The following extracts connected with wheat diseases are taken from Mr. Thorold's annual report:—

"*Yellow Rust*.—I reported in 1933 that I had received from Germany the varieties which are used there to differentiate the physiologic forms of *Puccinia glumarum*. These varieties have been grown at Molo and at Njoro. There were indications that a different physiologic form was present in November, 1934, from that occurring in 1933.

"*Take-all*.—The experimental plot at Messrs. Sayers Bros. was planted with several varieties of grasses. In practically every case the grasses are well established, thus initiating what should be a most useful and interesting

experiment. This was foreshadowed in my report for 1933, and the objects of the experiment explained. It is hoped to determine whether certain introduced and indigenous grasses can act as hosts for the 'take-all' fungus (*Ophiobolus graminis*). Such information is required in cases where it might be desirable to convert old wheat land into temporary pasture. (This investigation is being continued in collaboration with the Agricultural Officer at the Plant Breeding Station.)

“*Leaf Spot (Septoria tritici* Desm.).—This disease was recognized as occurring on a few wheat varieties at Molo. It is the first time that *Septoria tritici* has been noted in Kenya. This new occurrence need not occasion any alarm among wheat-growers; in other countries where the disease is common it seldom, if ever, causes any appreciable damage to the wheat crop.”

Maize.

Brown Discoloration of Seeds.

Some attention was given to a minor though fairly common disease of maize seed. This takes the form of a dark brown discoloration, sometimes appearing as striations, in a zone towards the germ end of the seed, just outside the portion which is inserted into the scaly tissues of the core. The coloration appears to be confined to the seed coat.

In numerous artificial cultures made from such affected seed a species of *Penicillium* mould developed with considerable consistency. Dr. Chas. Thom of Washington, an authority on the genus, to whom cultures were referred, placed the species near *P. pinophilum*, which belongs to a group which he has frequently obtained from maize.

In three germination tests of twenty seeds each, selected respectively for marked discoloration, slight discoloration, and almost complete freedom from the disease, germination was at least as prompt and vigorous in the first as in the last group. At the end of seven days all sixty seeds had germinated. In the field, twenty seeds selected for presence of considerable discoloration produced a perfect stand and grew as vigorously as maize from normal seed.

Attempts to produce the discoloration, by injecting a suspension of spores of the fungus in water between the leaf sheaths and grain of ears nearing maturity, produced only

traces of discoloration in the neighbourhood of the accidental abrasions caused by the needle of the hypodermic syringe employed for the purpose.

When slightly immature grain was sprayed with a similar suspension and then kept under conditions of poor ventilation in the laboratory, slight discoloration, but not of the typical dark brown colour, occurred in the region characteristic of the disease.

Diplodia Ear Rot (D. zeae Lev.).

The following extract is taken from Mr. Thorold's report :—

" In my report for 1933 it was mentioned that several specimens of this dry rot from the Trans Nzoia had been seen. In December, 1934, I had the opportunity of noting various types of ear-rot occurring in the Trans Nzoia, whilst assisting Mr. Maher in harvesting operations on his experimental plots. Although comparatively little pink ear-rot occurred this year, it was found that the *Diplodia* rot was rather common. It is to be hoped that this is merely a temporary and seasonal prevalence of what has previously been an uncommon and unimportant disease."

Barley.

Seed Treatments against Covered Smut (Ustilago Hordei).

Tests were carried out with two proprietary fungicidal dusts, Agrosan G and Abavit B, as seed treatments against covered smut.

The barley seed used was first inoculated with 0.25 per cent by weight of spores of the smut fungus. It was then divided into three batches, two of which were thoroughly dusted according to makers' recommendations with Agrosan G and Abavit B respectively. The remaining batch was left untreated as a control.

The above seed was then planted in 23 rows, each 20 yards long, as follows :—

Rows 1 and 23.—Outside rows, not included in experimental results.

Rows 3, 7, 11, 15 and 19.—Seed treated with Abavit B.

Rows 5, 9, 13, 17 and 21.—Seed treated with Agrosan G.

All even-numbered rows (total 11).—Untreated seed.

Counts of smutted heads were made at intervals after the crop came into ear, and the percentage infection was calculated as follows :—

Treatment	Percent Smutted Heads
Agrosan G	0.21 (S. E. 0.05)
Abavit B	0.65 (S. E. 0.13)
Untreated (Control) .	2.18 (S. E. 0.34)

Sorghum.

Seed Treatment against Grain Smut (Sphacelotheca Sorghi).

This disease having proved destructive in Borghanhilo sorghum at the Machakos Seed Farm, arrangements were made with the Agricultural Officer, Machakos, to test the effectiveness of the proprietary dust, Granosan, as a seed treatment against the smut. The experiment was carried out during the "short rains" season, 1933-34, and the layout used was generally similar to that described for the barley seed treatment above. Eight rows, 22 yards long, were planted with treated seed, and these alternated with rows on either side sown with untreated seed. The percentage of smutted heads in each treated row was compared with the average of that which occurred in the two adjoining control rows as follows :—

Percentage Smutted Heads in Treated Row	Average Percentage Smutted Heads in Two Adjacent Control Rows
4.8	69.8
0.3	60.9
2.7	62.4
0.0	52.8
1.9	51.9
0.0	55.7
0.0	46.0
0.0	45.3
Average 1.2	55.6

The weights of clean grain harvested, expressed as yield per acre, are given herewith :—

A. Untreated control rows 1,624 lb.

B. Granosan-treated rows 2,786 lb.

Increase, B over A : 71.6 per cent.

Potatoes.

Comparative trials were carried out at Njoro, with the assistance of the staff, between crops of Kerr's Pink from various sources, including some from originally virus-free stocks. The seed used was derived as follows:—

1. Kerr's Pink, Innishowen V.F. Virus-free stocks imported from Cambridge in 1931, since grown in isolation in wheat crops at Mau Summit, 8,500 ft.
2. Kerr's Pink, Gardiner V.F. As No. 1.
3. Kerr's Pink, Innishowen. As No. 1 till 1933. That year grown at Njoro, 7,000 ft.
4. Kerr's Pink, Gardiner. As No. 3.
5. Kerr's Pink. Ordinary commercial seed grown at Molo, 9,000 ft., for several seasons.
6. Kerr's Pink. Ordinary commercial seed grown at Njoro, 7,000 ft.

The plots were arranged in randomized blocks, with five replications.

If the highest yield, that of No. 5, is expressed as 100, the respective yields of all the trials are as follows:—

No. 5	...	...	...	...	100.0
No. 1	...	...	...	...	83.4
No. 4	...	...	...	...	81.2
No. 2	...	...	...	...	75.8
No. 3	...	...	...	...	70.0
No. 6	...	...	...	...	30.1

Statistical analysis shows that the yield of No. 5 is significantly greater than that of each of the others, and that the difference between No. 6 and all the others is also significant. There is a barely significant difference between Nos. 1 and 3, but none between Nos. 2, 3 and 4.

In connection with the superiority of No. 5, it must be stated that the seed of this variety used in planting the plots was somewhat superior to that of the others, which had been stored longer.

At the time of planting the above, small random samples were taken from each kind of seed and sent to Nairobi to be grown for observations on the presence or otherwise of virus diseases. The various batches of seed were grown in large

muslin cages, and were frequently sprayed with an insecticide to protect them from possible virus-carrying insects. During the course of the observations none such was seen.

Seven weeks after planting, Dr. Le Pelley, of the Entomological Section, who has had special experience with potato virus diseases, kindly examined the six plantings, and gave me his observations on the presence or absence of virus diseases, without prior reference to the plan of the experiment. The following is a summary of his conclusions :—

No. 1.—Out of eight plants, three symptomless, four with mosaic and one with leaf-roll.

No. 2.—Out of seven plants, one symptomless, two with mosaic, two with definite leaf-roll, and three with doubtful leaf-roll.

No. 3.—All plants vigorous and symptomless.

No. 4.—Out of nine plants, one with doubtful mosaic, six with definite leaf-roll, and two with doubtful leaf-roll.

No. 5.—All plants vigorous and symptomless.

No. 6.—All plants typically infected with leaf-roll and much smaller than those of any of the others above.

In spite of the above occurrences of virus disease, however, all the plantings with the exception of No. 3 would have been considered well up to or above average commercially.

To sum up the situation, it may be stated that over a period of three seasons the Kerr's Pink potatoes grown in isolation at Mau Summit have not fully maintained their original virus-free condition. While the present stocks appear still to be of good vigour, they cannot be said to be superior to other seed of the same variety grown at a fairly comparable altitude.

Special thanks are due to Mr. A. W. Hemphill, of Mau Summit, for multiplying the seed from the original virus-free stocks and for supplying the quantities required for the trials described above.

Linseed.

Stem-break Disease (Polyspora lini).

This disease, which had not been reported for some years, occurred in severe form in a crop of Bison linseed under trial at Njoro. Mr. Ball, Agricultural Officer, states that this variety suffered to the extent of 43 per cent. Among the other varieties under trial, Bullmoose showed 4 per cent and Persian

Gulf about 0.25 per cent infection, while Redwing, Rio, Ottawa 770 B, Morocco, and La Plata showed no disease at all. Mr. Ball concludes that "The disease would not appear to constitute a serious difficulty in the cultivation of linseed, since the best varieties appear immune or highly resistant."

GENERAL.

Sugar Cane.

At the Amani Conference in February, the opportunity was taken of obtaining the views of other officers interested in the matter on the advisability or desirability of continuing measures for the eradication of mosaic disease in Nyanza Province. While it was agreed that in the past an attempt at complete eradication had to be made in spite of all the difficulties involved, it was considered that, in view of the fact that considerable quantities of varieties immune from or highly resistant to mosaic are now available to growers, eradication of the disease is no longer essential. The decision was therefore taken not to continue the destruction of mosaic-infected cane in Nyanza Province. The quarantine order, whereby no material of susceptible varieties may be transferred from within the Province to areas outside of it, is, however, still maintained.

Through the courtesy of the Uganda Mycologist, Mr. C. G. Hansford, a few setts of the following sugar varieties not previously imported were received for trial: P.O.J. 2822, 2946, 2947 and 2952. These have all become well established.

The three sugarcane-sorghum hybrids, Nos. Co. 351, 352 and 355, which were mentioned in last year's report as having been received from India, have continued to make poor progress at the laboratories. In November, Co. 351 flowered, the inflorescence being of the sugarcane type. Seed pieces of each variety were sent to Muhoroni early in the year, but so far have given little promise of success. A further sugarcane-sorghum hybrid, No. Co. 515, was sent by the Government Sugarcane Expert, Coimbatore, and was planted in April. The six setts received all germinated, and the plants have shown rather greater vigour than those previously obtained, but they do not appear likely to prove very successful.

Striga Weed.

Mr. C. D. Knight, Plant Inspector, was responsible for all inspection work required to ensure the eradication of *Striga*

weed (*Striga hermonthica* Benth.) in Kisumu-Londiani district. While a general watch for neglected *Striga* weed throughout the area was kept, known danger spots were concentrated upon.

Mr. Knight reports that there was considerably less *Striga* than in 1933, except in Kibos area, where an increase was noted. All maize-growers concerned made genuine efforts to deal with the parasite, and it was not found necessary to institute legal proceedings in any instance. The weed is no longer a menace on the European farms, although routine eradication measures cannot, of course, be neglected.

Special Work.

Mr. Thorold reports as follows on work which he carried out during his leave :—

“ Whilst in England I attended the meetings of the Third Imperial Mycological Conference, held at the Imperial College, South Kensington, on 17th to 22nd September. At the session devoted to foot-rots of cereals, I read a paper on their occurrence in Kenya. It was particularly valuable to me to hear the views of delegates from the various countries where these cereal diseases are important.

“ The opportunity was taken during my leave to visit a number of agricultural and scientific institutions and research stations in England. One can hardly over-estimate the value of making personal contacts in this way, and of gaining first-hand information on the progress of investigations with which one's work is related. I would like to take this opportunity of thanking the respective directors and staffs for their courtesy and assistance extended to me.

“ The following places were visited :—

The Imperial Mycological Institute.

Imperial Bureau of Agricultural Parasitology.

Imperial Bureau of Fruit Production and East Malling Research Station.

The Royal Botanic Gardens, Kew.

Rothamsted Experimental Station.

Imperial Chemical Industries at Jealott's Hill Research Station, I.C.I. House, and at Manchester.

Long Ashton Agricultural and Horticultural Research Station.

Cambridge University Schools of Botany and Agriculture.

Armstrong College, Newcastle-on-Tyne.”

New Plant Disease Records.

The following are plant disease records new to Kenya :—

1. Maize	On old stalks .	<i>Gibberella fujikuroi</i> (Saw.) Wr. var. <i>subglutinans</i> Edw. —
2. Maize	From seeds ..	<i>Colletotrichum graminicolum</i> — (Ces.) Wilson.
3. Maize	From seeds ..	<i>Penicillium</i> sp. near <i>P.</i> <i>pinophilum</i> Hedgcock.
4. Wheat	Leaf spot ..	<i>Septoria tritici</i> Desm.
5. Barley	Leaf blotch ..	<i>Rhynchosporium secalis</i> (Oudem.) Davis.
6. Barley	Stripe	<i>Helminthosporium gramineum</i> — Rabenh.
7. Rye	Brown rust ..	<i>Puccinia secalina</i> Grove. —
8. Horse bean (<i>Vicia faba</i>) .	Leaf spot ..	<i>Ascochyta pisi</i> Lib. —
9. Pear	From root ..	<i>Peraneutypa</i> sp.
10. <i>Lupinus termis</i>	Rust	<i>Uromyces renovatus</i> Syd.
11. <i>Lippia asperifolia</i> Rich ..	Rust	<i>Aecidium</i> sp.
12. <i>Hypericum</i> sp.	Rust	<i>Sorataea</i> sp.

The locust fungus, *Empusa grylli* Fresen., was observed near Nairobi during the year on various grasshoppers, including *Catantops* sp.

The following are previously unrecorded wood-rotting fungi :—

Stereum bicolor (Pers.) Fr.

Stereum cinerascens (Schw.) Mass.

Sarcoxydon aurantiacum Pat.

Acknowledgments.

It remains, in conclusion, to acknowledge the usual valuable assistance received during the year from the Directors and staffs of the Royal Botanic Gardens, Kew, and the Imperial Mycological Institute, Kew, and to thank all those whose names have been mentioned in the course of this report for help rendered in various ways.

J. McDONALD,
Senior Mycologist.

CHEMICAL SECTION

ANNUAL REPORT OF THE SENIOR AGRICULTURAL CHEMIST,

STAFF.

The Soil Chemist, Mr. G. H. Gethin Jones, was on long leave from 16th May to 24th December.

ANALYTICAL WORK DONE.

Classification of Samples Received.

NATURE OF SAMPLE	Out- standing 31-12-33	Received	Examined	Refused	Out- standing 31-12-34
Dips	3	323	325	1	—
Wireworm Remedy .	3	18	21	—	—
Toxicological ..	—	68	67	1	—
Milks	—	5	5	—	—
Feeding Stuffs ..	—	17	5	12	—
Soils	—	382	382	—	—
Manures	—	34	34	—	—
Waters	—	16	16	—	—
Insecticides .. .	—	12	12	—	—
Essential Oils ..	—	42	42	—	—
Coffee	—	12	12	—	—
Oil Seeds	—	10	10	—	—
Miscellaneous ..	—	52	52	—	—
TOTALS ..	6	991	983	14	—

DIVISION OF ANIMAL INDUSTRY.

During the year arrangements were made whereby the routine work for the Division of Animal Industry, such as dip analyses, examination of ingesta for arsenic, and milk testing, was taken over by the Veterinary Research Laboratory from 30th September. The detailed report on dips, etc., will thus appear in that report.

The majority of the feeding-stuff samples received came from a private source, but, as the fees were not paid, the service was refused. Now that the section has been relieved of the dip analyses it will be possible for a number of analyses of grass and local feeding-stuffs to be undertaken.

DIVISION OF PLANT INDUSTRY.

Soils.

The work of the Soil Chemist is discussed by him in a separate report attached hereto.

A great deal of other soil work has been done during the year. About 100 samples were received from Messrs. Sampson and Harris in connection with the Tana River Irrigation Survey and examined here. Many of the samples were examined fully, soluble salts, pH, and permeability being determined. The results of the analyses showed that many of the soil types are unsuitable for irrigation, containing large quantities of soluble sodium salts and being highly impermeable. One type, containing large quantities of gypsum, was considered to be admirably suitable. The results of the analysis of the samples from this reconnaissance survey also showed that a close irrigational soil survey is needed before any steps are taken to construct irrigation works or to lay out land for cultivation. Such a survey would occupy at least a year.

As a result of observations made during the analyses of water extracts of the Tana River soils, a method has been evolved, in conjunction with Mr. McNaughtan, for the rapid determination of exchangeable bases. This method is now being employed in an attempt to elucidate the relationship between soil acidity and the distribution of coffee roots. At the time of reporting, however, insufficient data have been accumulated to permit of any conclusions being drawn.

The investigation into the distribution of nitrates in soil under coffee being conducted by Mr. McNaughtan has been greatly impeded by the long-continued drought. Nevertheless, some very interesting observations have been made during the past year. It would appear, for instance, that owing to the severe drought of 1932 coffee roots have penetrated more deeply into the soil, and are making use of water carried at great depths. This last year, with the soil down to 7 and 8 feet as dry as in 1932, coffee was showing no signs of wilting. It has not been possible to follow up this observation by washing out roots to a depth of 12 or 14 feet.

Soil Erosion.

With the Soil Chemist, a soil erosion survey has been planned and agricultural officers have been circularized. From information received and in our possession, it is evident that soil erosion is rapidly becoming a severe problem in Kenya.

Large areas have been damaged very considerably by sheet erosion. Gully erosion is also making its presence felt. Fortunately, many of the farming community have realized the damage, and the time was ripe for an erosion "drive". A long bulletin, describing and discussing various aspects of soil erosion and soil conservation, has been published. In addition, collaborating with Mr. Bailey, a number of Press notes have been published drawing attention to the dangers of erosion. Demonstrations have been given by agricultural officers.

Manures.

In collaboration with officers of the Department and others, work has been continued on methods of composting, and the conclusion has been reached that the most suitable methods for use in Kenya are those based on the Indore method, involving light waterings and well-aerated piles. A bulletin has been published on this subject.

Waters.

A few waters continue to be received for report on their suitability for irrigation. On the whole most samples received are suitable, only very seldom do any contain sufficient soluble salts to merit special precautions being taken in their use.

Pyrethrum.

All except one of the samples under the heading of insecticides were pyrethrum.

The pyrethrum industry is spreading rapidly. It is necessary to know if altitude affects quality, if the methods of drying do so, and to be able to estimate pyrethrins in flowers from single plants upon which to base selection work. It has been found extraordinarily difficult to adapt methods worked out elsewhere for this purpose. Methods based upon the use of low boiling point solvents and those involving heating at boiling point of water are unsuitable. In the case of the first, expense, owing to excessive evaporation, is the limiting factor, in the other the difference between the boiling point at sea level and at our altitude prevents its use. After much experimentation the quick method of Tattersfield and Martin for total pyrethrins has been found suitable to our purpose and work is in hand on a series of samples taken in conjunction with a survey designed to ascertain if altitude has any effect on pyrethrin content.

A grant has been obtained from the Colonial Development Fund to enable us to prosecute a study of pyrethrum driers. The apparatus arrived at the end of the year only.

Essential Oils.

The work on geranium oils has been hampered to a certain extent by the drought, which slowed down growth considerably and laid the plants open to attack by the fungus *Rhizoctonia solane*, identified by the Mycologist, Mr. Thorold. The disease is not serious, as only isolated plants are affected, contiguous plants being unaffected. Although growth was slow it was possible to issue 15,000 cuttings for propagation from the selected varieties of geranium.

The drought conditions enabled us to confirm the statement that oil quality varies according to climatic conditions. Oil distilled after a long period of drought was of far better quality than that distilled after a period of rain. As regards yield only "variety 3" was seriously affected, after drought the yield of oil was rather less than 0.1 per cent, after rain the yield increased to over 0.2 per cent.

Peppermint has been severely affected by the drought, assuming a prostrate habit. When good rains fell there was an immediate response in the production of erect growth. The greatest disadvantage in the development of prostrate growth lies in the choking of the ground by suckers. Ploughing so as to destroy a great proportion of the suckers is a temporary alleviative. It may be necessary to regard peppermint as a short period crop and plant up fields at intervals of two years.

Lavender has proved a puzzle this year. Through the kind services of Mr. Bovill of Messrs. R. C. Treat & Co., several new varieties have been introduced. During his search for a suitable variety Mr. Bovill enlisted the help of the Royal Botanical Gardens at Kew and the Royal Horticultural Society by whom it was discovered that English Lavender was not *Lavandula vera* but a hybrid of long standing. After many endeavours Mr. Bovill has succeeded in obtaining three strains of *L. vera* from France which are now established on Mr. Soames' farm at Molo where they will be grown experimentally and kept under observation.

Cedarwood oil is not in as happy a position as at the time of last reporting. The supply has exceeded the demand and producers have had difficulty in disposing of their product;

however, from market reports available, it appears Kenya oil commands a higher price than American. During the year several interesting observations have been made on this oil which call for further work.

A grant was obtained from the Colonial Development Fund for the purchase and installation of essential oil plant. This plant will enable us to extend our studies on the distillation of essential oils and to work on a semi-commercial scale. In addition extraction and rectifying plant have also been obtained which will enable us to further our investigations upon some of the newer oils.

The development of the essential oil laboratory at the Scott Laboratory is interesting. When first work was started on the subject the still used was a laboratory still capable of holding five or six pounds and the boiler a petrol can. The next outfit was a local still with a boiler capable of working to 40 lb. pressure. Here we could treat 50 lb. of material at a time. The present plant consists of two stills, capable of taking a 250 lb. charge, of different design, provided with open and closed steam coils, and designed so that they may be direct fire-heated. The two condensers are of different types and the steam plant will work up to 120 lb. pressure. This plant will enable us to study closely the different methods of distillation and provide information of great value to the developing industry.

Coffee.

The work on coffee has been continued as a result of which certain nebulous ideas based on observations over a long period have been crystallized. Dieback due to insufficient carbohydrate reserves to meet the needs of the developing crop had been recognized in one area a few years ago. Last year it was discovered that the dominant type of dieback in the Kisumu-Londiani district was not due to a lack of nitrogen but to carbohydrate deficiency. In this form of dieback the greater part of the crop develops normally but is accompanied by severe root dieback which immediately results in the development of intermittent bearing. Papers are being written describing the condition and the methods that should be used to obviate it.

It is useless applying nitrogen when yellowing, due to this cause, appears; it is then too late. The nitrogen, whether artificial or organic, must be applied early to improve leafage

and thus increase the production of carbohydrates. Where this has been done yellowing, dieback and intermittent bearing have become very slight indeed.

Drought conditions have caused yellowing and dieback, due, as far as can be ascertained, to a deficiency of carbohydrate, at the Scott Agricultural Laboratories, a condition never before observed here.

Miscellaneous.

The only items under this heading worthy of mention are a few samples of Madagascar butter beans, grown from seed showing marked true yellow eye. There was very little "black eye" in the samples. In one or two cases there was a yellow coloration around the hilum, apparently "yellow eye", but on closer detailed examination it was found to be a pure yellow rather than the yellow-green of "yellow eye". One is forced to conclude that the condition of "black eye" is not inherent to the seed but is due to external circumstances.

There was a notable response by the farming community, as shown by correspondence and numbers of visitors, to any special subject brought to their attention. Among these may be mentioned composting, soil erosion, pyrethrum and essential oils.

The writer attended the second Conference of East African Soil Chemists held at Zanzibar. The proceedings of this Conference will be published elsewhere.

The thanks of the section and the Department are due to the Commissioners of the Colonial Development Fund for the grants they have made for apparatus and plant and to Mr. Bovill for his labour in obtaining true *Lavandula vera* and introducing it here. The writer, too, wishes to record his personal thanks to Mr. R. O. Barnes for much detailed information supplied regarding soil conservation measures.

V. A. BECKLEY,
Senior Agricultural Chemist.

REPORT OF THE SOIL CHEMIST

Some 382 soil samples and 34 fertilizer samples have been dealt with. An analysis of the soil work gives the following classification of laboratory work involving soil analyses: 51 soil samples were examined and reported upon for private individuals; 255 dealt with laboratory investigational work; most of the remainder were taken in connection with soil survey work. The majority of soils examined for private individuals were brought to the laboratories, where simple quantitative soil nutrient examinations were carried out, and advice given accordingly. Exact quantitative analyses of the so-called "available" soil nutrients, for which certain schedule fees are chargeable, are of but limited value, as other soil factors, which cannot be estimated on the laboratory sample, often exert a greater influence on the general fertility of the soil for specific crop production. The chemical section would again encourage farmers to bring representative soil samples to these laboratories, where manurial and cultural problems can be discussed and simple soil tests carried out free of all charges.

Soil Investigational Work.

Laboratory work on the phosphate status of the Kikuyu red loams, with special reference to the availability of organic phosphate, has been continued. A delicate equilibrium has been found to exist between the so-called "available" and "unavailable" phosphoric oxide content of the soil. There is a rapid replacement from reserves as the more available portion is removed by plant growth, and again added soluble phosphatic fertilizers show an equally rapid change-over from "available" to "unavailable". The addition of both organic matter and phosphate has now been recognized as a feature of good coffee husbandry. Field evidence indicates that added phosphate shows a greater response when added to red soils that are not low in organic matter. It is believed that this is brought about due to a greater proportion of the added phosphate being held in conjunction with soil humus and thus protected, whereas less gets temporarily tied up to the reactive mineral colloids of the soil. Laboratory experiments on miniature compost pits are now being carried out to find out to what extent added phosphate may be more beneficially applied to the soil via the compost pit. It is appreciated that the treatment will perhaps lessen the solubility of the phosphate as determined by arbitrary laboratory methods, but it is believed that on the whole the protection from reversion would be beneficial in the special case of the red coffee soils.

During recent years many thousands of acres of papyrus and *Ithangi*-fern swamps have been systematically drained and developed to produce good yields of a wide range of both subsistence and cash crops, more especially those which are associated with much vegetative growth. In the native reserves a sequence of very dry seasons, resulting in partial crop failure and a scarcity of foodstuffs in areas of partly worn-out soils, has led agricultural officers to organize the laborious task of excavating main and feeder drainage channels and the clearing of these swamps. The peaty soils contain some 35 per cent of accumulated organic matter, and they are very acid in reaction, having pH values of the order of 4.0. However, they produce crops which show no symptoms of excessive acidity, and hence a different interpretation of soil acidity has to be applied to these peaty soils with a permanently high water-table. Some laboratory work shows that these soils become less acid when the organic matter is allowed to decompose under more aerobic conditions, and it is probable that with effective control of the drainage that these extensive areas of old swamp land will constitute a naturally fertile soil for many decades.

Sand-culture work with coffee has been continued. With the exception of the nitrogen-starved tree, the series of coffee trees growing in sand culture with various nutrients produced very heavy crops in relation to the amount of leaf on the trees. They have suffered severely from leaf-fall and dieback, due to carbohydrate deficiency. Examination shows that, although the dried berries contain a certain amount of small beans, all portions of the trees including the root system have suffered very severely from attempting to overbear, leaving much dead wood and root tissues. The damage to the trees bears a closer relation to the attempted overbearing than to any differences in nutrition. The previously least vigorous nitrogen-starved tree bore only a small crop, with the result that it now carries the most leaf and the least dead tissues. It is to be noted that overbearing, due to carbohydrate deficiency, that is, attempting to mature a crop that is out of proportion to the effective amount of leaf, can bring about a very drastic setback to the coffee tree, confirming the conclusions based upon many field observations reported elsewhere.

Grassland manurial experiments, carried out in conjunction with the Officer in Charge of Grassland Improvement, have been continued at the three Government veterinary stations. Up to the present a sequence of severe drought has obscured any marked results. However, the major portion of

the applied fertilizers have neither been leached out nor utilized by the herbage, so with additional nitrogen top-dressings one might expect any response to become apparent when seasons again become normal.

Manures.

The fertilizers analysed during the year consist mainly of waste farm materials, local animal by-product manures, wood ashes, limestones, guanos and mixed fertilizers. It is pleasing to record that much more attention is now being paid to the utilization of local manurial by-products. The suitability of bone meal and carcass meal for the red coffee soils is being realized, and the demand for these materials has resulted in their commercial production as an established local industry.

The limestone survey has been continued, and has shown that local deposits of fair to high quality limestone occur throughout the Colony. The district with the least suitable local supplies is the Trans Nzoia, but arrangements have now been made so that this important arable area may obtain relatively cheap supplies from outside sources. Field experiments now being undertaken by the Department should in the near future give a better idea of the economic role of liming in the arable districts.

Soil Classification and Nomenclature.

In conjunction with the Senior Agricultural Chemist, a tentative universal soil classification, based on broad climatic soil types, has been suggested for the better known parts of the Colony. Such a map on a scale of 1:1,000,000 has been submitted to the Third International Congress of Soil Science for inclusion in a World Soil Map. The main natural soil groups described are the Light-coloured Plains Soils, Black and Grey Earths, Calcareous Black Earths, Non-calcareous Black and Grey Earths, Laterized Earths, Non-laterized Red Earths, Volcanics and Alluvium.

A second system of soil survey and classification has been carried out with much more detail. Up to the present some thirty three soil series, most of which reoccur in various parts of the Colony, have been described and representative profile samples taken. All such soil samples are recorded under a double index system. There is a district classification, in which is noted the locality, altitude, rainfall, natural vegetation, extent of occurrence and agricultural characteristics of the different soil series. Again, there is a series classification

recording parent material, soil colour, mode of formation, field texture, topography, soil-water conditions, profile development, depth of sampling, and any laboratory analyses carried out. This method has since been adopted for general use throughout the East African territories.

During the year the Department has initiated a reconnaissance survey of the severity and extent of soil erosion. Arbitrary divisions of the intensity of erosion have been decided upon, thus putting the survey on a uniform quantitative basis throughout the Colony. This Kenya scheme has been approved by the Conference of East African Agricultural and Soil Chemists, and has been recommended for consideration by the Governments of the other territories.

G. H. GETHIN JONES,
Soil Chemist.

PLANT BREEDING SECTION

ANNUAL REPORT OF THE SENIOR PLANT BREEDER AND EXPERIMENTALIST

I reverted to my substantive post as Senior Plant Breeder and Experimentalist at the end of 1933 but remained stationed in Nairobi during the whole of 1934 and was placed in charge of all plant breeding and field investigational work on annual crops in European areas and assisted in similar work in native areas in an advisory capacity.

Mr. Lathbury remained in direct charge of the Plant Breeding Station, Njoro, and undertook most of the work on wheat breeding at Njoro and its two sub-stations of Molo and the Scott Laboratories.

Mr. Noble was on long leave from the end of April until the end of December and his place at the Scott Laboratories was taken by Mr. Gamble who was transferred from Kitale.

On the return of Mr. Thorold, Mycologist, from long leave he did not return to the Plant Breeding Station as he had completed the special work on cereal diseases on which he was engaged the previous tour.

Mr. R. S. Ball, Agricultural Officer, was posted to the Plant Breeding Station on his arrival in the Colony on February 10th. Throughout the year he acted as assistant to Mr. Lathbury and was able to relieve Mr. R. J. Benstead, District Agricultural Officer, of much of the field work on the station.

The reports on investigational work in European areas appear in the reports of the Agricultural Officers, Njoro, Nakuru and Kitale. This work is on a well organized basis and follows a similar plan throughout, modified in accordance with the varied environmental conditions obtaining in the different districts where work is being done. Crop trials of cash crops still continue but the ground in this respect has been fairly well covered during the past few years and farmers are aware which crops would do well on their farms when prices become sufficiently attractive. Considerable attention is being given to trials of grasses and forage crops with a view to assisting farmers towards turning over from the one crop to a mixed farming system, and small herds of native cattle at Njoro and Kitale are used to help in this

work. The rest of the investigational work is mainly concerned with finding an economic method of incorporating green manuring into the straight crop farming system since most of the lands under crop to-day are urgently in need of improvement by organic manuring. In the drier areas it is thought that the use of compost will be more certain and effective.

During the year I went on tour in the native areas of the Nyanza, Central and Coast provinces in order to inspect and advise on the investigational work on crops and crop production and the technique which should be adopted. Except at the Coast there are few facilities for investigational work or, it is better to say perhaps, the staff is so fully occupied with extension work and development that there is little time to devote to investigational work of anything but the simplest nature. Nevertheless these tours undoubtedly resulted in the dissemination of much useful knowledge on methods of experimentation, on the selection of maize seed and on methods of conducting crop trials. This last is particularly important as, unless crop trials for purposes of comparison of yields are properly done, it is difficult to reach sound conclusions as to what crops and varieties to recommend.

The breeding of rust-resistant wheats remains the most important work of the Plant Breeding Services with maize breeding coming next in importance. Work is, however, being done on other crops also. An attempt is being made to breed a more prolific strain of pyrethrum. The ordinary awnless millet is very susceptible to birds and work has begun on breeding a pure strain with really long awns which should prove uninviting to birds.

Advice is also given on the work on the Coast Experimental Station at Kibarani, particularly as to the methods to be adopted for breeding a wilt-resistant strain of ground-nuts; this work on groundnuts is the particular responsibility of the Agricultural Officer, Coast, and is of an extremely important nature since ground-nuts cannot be grown in the coastal belt unless a wilt-resistant strain is found or bred. Ground-nuts are potentially a most valuable crop for the Coast as they grow well until destroyed by wilt.

WHEAT—GENERAL.

The wheat industry has experienced another successful year. The acreage seeded shows a slight increase whilst the yield per acre is likely to remain constant at about four bags

per acre. There will therefore be little wheat available for export and the price to the grower should remain high, say in the region of Sh. 16 per bag of 200 lb.

The season has been a dry one and the yield has suffered in some districts from lack of rain. On the whole, however, the rains fell when required and very fair harvests have in general been reaped.

A survey of the main varieties of wheat grown shows that Kenya Governor, N.B. 230, Sabanero and Equator were the most popular varieties, in that order. The first two wheats are both government productions. Kenya Governor cannot be recommended in those areas where stem rust is usually prevalent and it is likely soon to be replaced by the new Kabete wheats and by the new wheat B.256.G.

N.B. 230 is still at the moment the safest wheat to grow in the high altitude districts. It has in a few cases been attacked by stem rust but the form to which it was exposed is not the usual form experienced in the high areas. It will in due time it is hoped be replaced by some of the new Njoro wheats such as Cross No. 112 and 130.

Sabanero, the most stem-rust-resistant wheat of the four, has only met with a modicum of success. Like Equator it does not yield as well as it promises. It also possesses soft straw, and is of indifferent baking value. It is, however, a useful stop-gap at the moment, particularly for areas between 7,500 and 8,000 feet as it is resistant to yellow rust up to 8,000 feet.

Equator, whilst a good wheat in many respects, cannot be recommended owing to its susceptibility to stem rust.

Other varieties worthy of mention are Burbank and B.256.C.3. (L) both of which might well replace Kenya Governor for the present; the former because it possesses rather more resistance to stem rust and the latter because, whilst having the same stem rust susceptibility, it stands up better in the field and does not shed its grain so easily.

As stated in my annual report for 1933 all varieties in general use are very mixed. Whilst every endeavour is being made to keep the new issues of wheat in a pure state it behoves every wheat grower both by eradication of volunteer plants and by careful cleaning of all wheat machinery to maintain a reasonable standard of purity in his wheat.

Stem rust and physiologic forms.

The year has been noteworthy for the presence of the latest discovered form, No. K.4, over all the highland country, and whilst owing to the dry season little damage by rust has been observed, yet in nearly every case where rust has been seen it has been found to be this form. It has even invaded the high altitude areas where form K.2 is the usual rust, but this invasion is likely to be due to the very dry season and it does not follow that this form will be present there in a more normal season.

Whenever opportunity occurred specimens of stem rust were collected in the different districts and sent to the Mycological Section for identification of the physiologic form or forms present. Differentiation of more than one form from one wheat is not easy and for this and other reasons it was felt that field determinations should be made also. The four Kenya differential hosts which are habitually grown in the breeding cages at Molo, Njoro and the Scott Laboratories were also sent therefore to ten farmers in various districts who had new wheats under trial and multiplication. The differentials were grown in juxtaposition to the new wheats and an examination of them not only disclosed which physiologic form or forms, if any, were present but the degree (by comparison) of resistance possessed in the field by the new wheats. That is of course the final test. In some districts no stem rust was present, in others form K.4 was present, whilst at Thomson's Falls (8,000 ft.) two forms, K.1 and K.4 were present at once.

The Dominion Rust Research Laboratory, Winnipeg, very kindly offered to grow any new wheats in their nurseries and note their behaviour to stem rust. Accordingly selections from crosses Nos. 112, 122, 131, 58 and 60 were sent, and the subsequent report states that the first four selections were completely uninfected and would appear to be highly resistant. Cross No. 60 showed a 10 per cent infection. Susceptible varieties in the same test ranged from 65 per cent infection upwards.

A further small series of Canadian wheats were received for trial of which Double Cross 2303 alone showed resistance to stem rust. Seedling inoculations on this wheat tended to confirm this resistance. Double Cross x Ceres 721 which has shown resistance in the past two years is also being continued with.

Diseases.

Little damage was caused by rust or other diseases this year. Adherence to the control measures advocated for "Take-all" has resulted in the eradication of this disease to a great extent, but it is still present and farmers must therefore take every care both to watch for its presence and to adopt measures for its control when found. At the Plant Breeding Station, Njoro, it was found that the insertion of an alternate crop for one year only in the rotation was insufficient to eradicate the disease and it is recommended that infected land be rested from wheat and other pest plants for two years.

An infection of root-rot followed the July-August rains in the Rongai valley, fortunately with little subsequent damage to the crop. Caterpillars also did slight damage to the standing crop in some areas. This damage can be attributed to the drought. Black Chaff and Glume Blotch were practically non-existent throughout the country.

Mercurial Dusts.

As the use of these dusts for dressing wheat and other cereal seeds has obtained some popularity in Europe, an experiment was laid down testing Agrosan G, Abavit and Granosan, three proprietary dusts at present on the market. Wheat and oats were both used as the cereal crop. No significant results were obtained, due possibly to the very dry season experienced.

Darnel.

This weed is now widespread on the Plateau and it has already been carried to other districts by means of contaminated wheat seed. It is impossible to separate darnel seeds from wheat seeds by winnowing but they can be largely got rid of by letting the wheat run over a rough blanket when the darnel seeds are left behind as the serrated awns hook on to the cloth. Also it is a comparatively simple weed to eradicate by hand pulling in the field as it comes away ahead of the wheat. Darnel gives a bad flavour to flour.

Analyses of Baking Quality.

A large number of new wheats were sent to England, through the courtesy of Messrs. Unga Ltd., the flour millers, for analyses of baking quality of a physico-chemical nature. The exact results of these tests cannot at present be disclosed, as they are confidential, but it can be said that the general run of Kenya wheats are of similar quality to Barusso wheats, some being better and some worse. A number of the new

wheats are of about this quality but some are very much better, approaching, on the basis of this kind of test, the quality of Manitoba No. 2. These tests are of course by no means final—the final test consists of making a loaf of bread—but experience shows that they give an excellent indication of baking quality and they can be done with only two or three pounds of wheat; in other words they can be carried out when a wheat is in the very early stages of trial. Given a large series of new wheats of similar type, yield and rust-resistance, the final selections can be done on a basis of comparative baking quality and, but for these analyses, such selections would be of a rather speculative character with regard to the finer points of baking quality.

In order that too great a proportion of seed of new wheats may not have to be used up for even these baking tests it is necessary to multiply each of them up to about 40 lb., necessitating at least one more season than if reliable tests could be made whilst the wheats were still in the "ounce" stage. This is a great nuisance when large numbers of wheats are involved. The Chemical Section undertook therefore to experiment with the use of Pelshenke's Wholemeal Fermentation Time test and when a satisfactory local technique was evolved the work would be handed over to the Plant Breeding Services for routine testing of wheats. This method only necessitates the employment of 40 grammes of wheat and so can be employed the season immediately following that in which any hybrid breeds true to type. Pelshenke's test is largely one for "general strength" (an important item is baking quality) and should serve well enough as an indication, early on in a wheat's history, of its probable baking quality. The experiments were held up owing to the wrong type of mill being sent out and to difficulty in obtaining uniform yeast, but it is expected that the test will be employed in 1935.

Wheat Breeding at the Plant Breeding Station, Njoro.

The very late advent and subsequent paucity of the rains at Njoro resulted in small yields and gave rise to anxiety as to the possible loss of the plants themselves. A few wheats were sown in the middle of May but the bulk of the wheats were fortunately kept back for July sowing and from these latter wheats a fair amount of grain was harvested, though irrigation and watering was perforce adopted for a period of two months. The quality of the grain was surprisingly good.

Such a season was naturally unfavourable to the spread of stem rust. However the cage "surround" of Marquis was inoculated with all forms of stem rust sent up from the Scott Agricultural Laboratories by the Senior Mycologist. A spore suspension in water of each form was made up separately and used for injecting the surround wheats in the piping stage. The "take" with all forms was successful, pustules appearing about four to five weeks after injection. The subsequent spread was small due to unfavourable climatic conditions. The epidemic however permitted of a reasonable amount of rust selection work being performed. This method of inoculation performed at the piping stage is simpler than that performed at the seedling stage, as the injection of the spores together with the water in which they are suspended obviates the need of subsequent spraying and covering with bell-jars to retain the necessary degree of humidity.

The "tester" wheats were as usual grown in the breeding cage to indicate what form or forms of stem rust were present. In addition two of them, namely Reliance (susceptible only to form K.3) and 112 A.1 (susceptible only to Form K.2), were sparsely mixed in with the "surround" of Marquis. Marquis is a white chaffed beardless wheat, whilst 112.A.1 possesses red chaff and Reliance has bearded ears. These two testers were therefore easily distinguishable amongst the Marquis and afforded a further means of identification of any natural form of stem rust present on the Marquis "surround".

A progress report on the different crosses follows :—

Cross No. 112—Njoro wheat x English hybrid.

Twenty bags of different strains of this cross were issued to farmers for trial and multiplication and, despite losses due to drought in some areas, over four hundred bags have been reaped. The outstanding qualities of these strains are their capacity to yield and their strength of straw. On small plots of four to five acres yields at the rate of twelve to thirteen bags per acre have been obtained at Molo at 9,000 feet, at Mau Summit at 8,300 feet and at Njoro at 7,000 feet. These wheats thresh easily and growers on this initial trial were pleased with them. They are heavy stoolers.

All the strains are medium-late maturing and vary as to their behaviour to yellow rust. The more resistant can be

grown up to 9,000 feet, at which height infection was negligible this year, though in 1933, during a more severe epidemic of yellow rust, a slight infection was observed. These wheats are accordingly suited to districts between 7,000 feet and 9,000 feet between which heights the bulk of the wheat produced in the country is grown.

Out of the four forms of stem rust so far differentiated in this Colony these wheats are moderately susceptible to form K.2 only, but this form was little in evidence during the year even at the high altitudes, and it still remains to be seen how they will react to this form during a severe epidemic. All strains showed susceptibility to leaf rust.

They would also appear to be drought resistant and one strain seeded at the end of August at Molo came off at over eight bags per acre. Incidentally NB.230.A.14 (L), grown alongside, was badly affected by a form of stem rust to which No. 112 is resistant, so much so that part of the crop was not even harvested.

The grain is mostly red and not particularly attractive in appearance. It has however bushelled up to 63 lb. in the field this season. A few white-grained strains are being built up from single plant selections as, in view of the atta trade, the mills greatly prefer white grained wheats.

Baking Quality.

Preliminary analyses of baking quality of a few strains showed a wide range of variation, the best strains being equal to No. 2 Manitoba, whilst other strains were no better than Equator. It is likely therefore that some of these wheats will be of satisfactory baking quality.

Cross No. 117 and 122.—Njoro wheat x Marquis.

These wheats have been steadily multiplied up and a few bags of seed are now available for issue to growers. They are in particular suited to the 7,000 feet zone as they are susceptible to yellow rust at the higher altitudes and can be replaced by quicker maturing varieties at the low altitudes. Their stem rust resistance is the same as that of Cross No. 112. One strain of these types, No. 122 D.I.T. (L), under trial at the Dominion Rust Research Laboratories, Winnipeg, was considered very promising there. Both red and white grain types of high baking quality, as shown by preliminary analyses, have been evolved from both crosses.

Cross No. 130—Njoro wheat by Australian Florence.

This is the most promising cross of all as regards rust resistance, some strains having been obtained resistant to all four forms of stem rust and also to yellow rust and possessing some resistance to leaf rust in addition. Those cultures grown at the high altitude cage at Molo in 1933 and found resistant to yellow rust there were carried on in small multiplication plots at Njoro this year. Owing to the drought the increase of seed has not been as great as was hoped, but 10 lb. to 40 lb. each of seed of a number of strains has been harvested. Seedling inoculations of these wheats, with the four forms of stem rust, by the Mycological Section, have facilitated differentiation between those resistant to four forms of stem rust and those resistant to three only. These wheats undoubtedly show promise of yielding well but in some cases they lack the necessary strength of straw and are not comparable to Cross No. 112 in this respect.

In addition to these multiplication plots a further series of cultures, which were tested for stem rust in the Njoro cage in 1933, have been grown on in the Molo cage this year, and selections made for resistance to yellow rust and strength of straw.

Some very attractive grain samples have been obtained from this cross the only fault being the length of grain of most of the samples. Though this does not appear to be affecting the bushel weight a number of plants with better shaped grain have been selected.

Whilst a number of valuable strains are at present being multiplied it is still hoped that one strain only will be isolated, combining in itself all the more important desirable characteristics of rust resistance, strong straw and good milling and baking quality.

It is of interest to note that Australian Florence is, in that country, thought to be likely to be immune to loose smut, and whilst loose smut has never become epidemic here, it is possible that some of these new strains may also possess this immunity.

Cross No. 131—Njoro wheat x Australian Florence.

The progeny of this cross was further tested for yellow rust at the Molo cage this year. The bulk of the strains will, however, have to be discarded owing to weak straw. A few

strains possessing better straw and grain and resistant to yellow rust are being carried on; strain No. 131 C.13 B. of this family produced grain which bushelled 63 lb. to 64 lb.

Resistance to form K.2 of stem rust has been more easily obtained in this cross, and it is hoped that something of value will eventually materialize. At the same time weak straw and badly shaped grain together with susceptibility to leaf rust are characteristics likely to detract from the quality of this wheat. Judging from the size of the ears, some of these wheats should be nevertheless very prolific yielders.

Cross No. 58—Red Egyptian x Kenya hybrid.

One strain has been multiplied and two bags of seed are now available for issue. This wheat is resistant to all four forms of stem rust, is moderately early and should suit areas of an altitude of 6,000 ft. to 7,000 ft. very well. A preliminary analysis of baking quality was not very satisfactory and the future of this wheat will rest on subsequent reports.

Cross No. 142—Njoro wheat x San Martin.

The bulk of this cross has been discarded and only a few strains will be carried on. These would appear to be resistant to stem rust, possess very strong straw, very fair ears and promising grain.

Cross No. 162—Kanred x Equator.

This cross, which is in the F3 generation, is disappointing, and only a few single plant selections have been kept.

Cross No. 133—Njoro wheat x Equator.

This cross was grown in the Molo cage and whilst it had previously shown itself resistant to yellow rust at Mau Summit, 8,500 feet, at Molo it was badly attacked by this rust. A few apparently resistant plants were found and harvested. This cross possesses excellent straw and is in other respects promising.

Cultures in the F2 generation of the following crosses were grown and plants resistant to stem rust selected :—

K.2.R.5 (L.2) x Reliance.

K.2.R.5 (L.2) x Marquis.

D.2.E.2.C.4 (L) x Selection out of Australian Florence.

Wheat No. B.256 G.

The multiplication of this wheat has been continued in the Rongai area and the 375 bags which were surplus to the growers' own seed requirements have been advertised for sale and issued to farmers. This is a moderately early wheat; it is susceptible only to form K.4 of stem rust but is susceptible to yellow rust over 7,000 ft. It has shown itself to be a better yielder than Kenya Governor and does not shatter or lodge to the extent that the latter does, though it does not possess strong straw. In a half drill strip yield trial at Njoro against Sabanero it yielded 8.12 bags per acre with a bushel weight of 58 lb. as against Sabanero's 6.25 bags per acre with a bushel weight of 54 lb. It is a white-grained wheat and likely to be at least as good as Kenya Governor from a baking point of view.

Yield Tests and Multiplication Plots.

Apart from the breeding cage, seven acres were under wheat at Njoro consisting of about a hundred multiplication plots, six half-drill yield tests and a randomised yield trial of twenty hybrid wheats. All the yield tests were severely affected by the drought and whilst significant results were obtained in some cases, too much importance cannot be attached to them under these conditions.

New Crosses.

A series of thirty-seven new crosses were made at Njoro and the Scott Agricultural Laboratories. Great things are expected of these crosses as the parents consist of wheats bred in past years which each lack only one or two of the characteristics required for suitable wheats for this Colony. These parental types were bred from wheats each possessing very few of the desired qualities so it was hardly to be expected that their immediate progeny would be entirely successful.

WHEAT BREEDING AT THE SCOTT AGRICULTURAL LABORATORIES.

73,000 hybrid plants of the second filial generation were sown in the breeding cage in the long rains season. These consisted of plants out of twenty-two crosses which had been made in the long rains of 1933, the F.1 generation having been grown in the short rains of the same year. It should be understood that the new "Kabete" wheats which were bred from crosses of which Kenya Standard was one of the parents are all susceptible to form K.4 of stem rust because Kenya Standard is susceptible to that form and was used as

a parent before form K.4 had been discovered. The new crosses from which the hybrids under reference have evolved were specifically made with the object of eliminating susceptibility to K.4.

A surround of Reward wheat was utilized for creating an artificial infection of all four forms of stem rust and a number of rust-resistant F.2 plants were harvested. These were mostly selected out of crosses between Reliance wheat and the Kabete wheats. Reliance is susceptible only to form K.3 whilst the Kabete wheats are susceptible only to form K.4.

A further series of six crosses was also made between the Kabete wheats and strains of Njoro wheats resistant to stem rust. The F.1 generation was grown on in the short rains season. The crosses were made with the object of shortening the time of maturity of some of the Njoro wheats and of eliminating susceptibility to stem rust form No. K.2 from some Njoro wheats and form No. K.4 from the Kabete wheats. Twenty-one different crosses were made and the parental wheats used were strains of the following hybrid families :—No. 112, No. 60, No. 286, No. 58, No. 117. Sabanero was also used.

A new technique for artificial pollination, taken from the *Journal of Heredity*, was tried. The pollen was obtained by stroking a spike about to blossom thus causing the ripe anthers to be exerted when the pollen could be shaken into a container. The pollen was then applied to the individual florets with a spatula. This procedure enabled pollen to be obtained without the necessity of opening individual flowers. Mr. Gamble reported that the above method was an improvement on the older methods of placing ripe anthers in each floret. He considered the operation quicker and the supply of pollen material went further, whilst the percentage of setting obtained was equally good.

A number of strains selected out of Sabanero were grown for trial and multiplication. Many of these proved susceptible to stem rust, but a few showed resistance. As, however, this variety has not fulfilled its earlier promise as a suitable wheat for bread-making it cannot now be recommended and growers are advised to discard it.

A yield trial of eighteen of the new Kabete wheats was laid down, each variety being replicated fifteen times. The strain placed first gave a yield 40 per cent better than that

placed last and it is hoped that this trial, in conjunction with analyses of baking quality, will enable this series of wheats to be cut down to three or four for final issue to farmers. Analyses of baking quality of these white-grained wheats are extremely promising.

Molo Sub-Station.

The high altitude cage on Marindas Farm (9,200 ft.) was again used with success as a yellow-rust testing station for the new strains of wheat bred at the other stations.

OATS.

Oats have never been a really satisfactory crop in this Colony. They tend to make too much vegetative growth, the grain rarely fills out and is usually of rather poor quality; whilst most varieties can be badly damaged by both stem and crown rust.

Some years ago a large number of varieties were imported for trial but all proved susceptible to rust and none gave good quality grain. A series of Australian varieties were, however, imported for trial this year through the kindness of the Director of Plant Breeding, Department of Agriculture, New South Wales. These varieties were tried both at Njoro and Molo. Their reactions to stem rust would seem to point to the fact that more than one physiologic form is present in this country. The variety Lampton showed itself resistant to stem rust at both centres and shows some promise as it also possesses suitable agronomic qualities.

One further variety, a hybrid bred by Sir Rowland Biffen, has been multiplied up for issue and trial on a small scale. This oat, whilst resistant to stem rust at Njoro, showed susceptibility to the form present at Molo. In other respects, however, it has done well at Njoro and suits the district, and the issue will therefore be confined to similar medium altitude areas.

MAIZE.

Maize Breeding at Njoro.

A number of officers are engaged on the work on maize improvement which is co-ordinated and directed by myself. Maize seed competitions are run at the Plant Breeding Station, at the Rongai plots and near Kitale. Mr. Maher, the Agricultural Officer, Kitale, is responsible for the maize breeding there; by a process of inbreeding (through selfing of individual plants) he is trying to produce strains of maize

resistant to White Blight (*Helminthosporium turcicum*) and to *Fusarium* diseases. Similar work is done by the Plant Breeder and Agricultural Officer at Njoro. At the Scott Agricultural Laboratories the method adopted for producing an early disease-resistant type of maize—called Muratha—is by strict selection in the field.

Mr. Lathbury reports: "At Njoro sixty-nine F.3 lines were planted and two hundred and seventy-seven plants were selfed. Considering the dry conditions experienced when the maize was in flower the "take" was good, on an average some ninety grains setting per cob.

The lines are now showing some degree of purity and are segregating out for such characters as earliness and lateness, strong and weak stems, susceptibility or resistance to disease, and height.

Fifty-one crosses embracing twenty-eight lines were made as a preliminary test for compatibility. Twenty-six lines embracing one hundred and thirty-three selections have been chosen for further propagation and inbreeding."

Mr. Maher reports: "At Kitale sixty-four F.4 lines and one hundred and forty-five F.3 lines were planted. In addition a plot of over half-an-acre was planted with open-pollinated mass-selected maize from the 1933 breeding plots: this maize grew splendidly and eventually yielded at the rate of twenty-one bags per acre which was a high yield for the season and the type of soil. About 450 plants were selfed. Selection at harvest time, aided by the records of susceptibility to disease in the field, reduced the number of cobs available for planting in 1935 to 144 F.5 lines, 122 F.4 lines and six F.2 lines, some of the F.4 lines including plants selected for susceptibility to white blight.

A great difference in susceptibility could be seen between the ordinary lines and those selected for susceptibility to white blight. The latter withered off at an early date and almost without exception failed to produce a cob. It would seem that mass selection by farmers of heavy cobs with bright grain will automatically and progressively tend to reduce their losses from white blight.

A similar great difference was noticed between various lines as to their susceptibilities to red rust (*Puccinia sorghi*). Unfortunately it has so far not been found possible to obtain information as to the extent to which yields of maize may be reduced by this fungus.

: The indications of the appearance of the cobs when examined at harvest went to show that a very high percentage of them are infected by *Fusarium moniliforme*, the ubiquitous *Fusarium* of maize in Kenya. It is to be hoped that, given almost invariable seed infection, some of the in-bred lines will show to a high degree lack of prejudicial effects in the field due to the infection. As regards ear rots it will be desirable to self enough plants in some of the F.5 lines in 1935 to show if there is any differential susceptibility in the progeny of the various lines."

Unless facilities for the work in the form of increased funds for materials, proper stores and so forth are provided for the Government plot near Kitale it will be impossible to carry this important work to fruition. Maize breeding of the type undertaken at Kitale and Njoro requires an organization comparable to that necessary for wheat breeding, as soon as the inbred lines have reached a stage when they are suitable for crossing for the production of new varieties.

At the Scott Agricultural Laboratories the work on improving Muratha maize was undertaken by Mr. Gamble, who was greatly helped by the interest taken in it by Mr. Gillett, the Agricultural Officer. Mr. Gillett reports: "Approximately 21 acres of land were planted up with this crop during the April rains. This consisted of $3\frac{1}{2}$ acres of seed selected the previous season for resistance to white blight, for good cobs and good plants. The remaining area was planted with seed selected in the crib. Owing to the drought conditions the stand had to be reduced to 4,840 plants per acre. Yields varied considerably according to the condition of the land. An average of approximately twelve bags per acre was harvested off a small plot on the smallholding, the $3\frac{1}{2}$ acres of special seed yielded approximately ten bags per acre, whilst 17 acres of crib selected seed grown on the new land only yielded approximately four-and-a-half bags.

The whole of the area planted was subjected to careful field selection. Different coloured tags for each selection were used in order to be able to differentiate them at harvest time. The marked plants were examined three times before harvest and only those plants which remained healthy were finally selected. In this way only about 40 per cent of the plants originally marked were harvested.

The following is a list of the different selections made :—

1. Plants growing in the 'resistance to white blight' plot which were completely free from any disease and at the same time strong and healthy;

2. Plants growing in the 'resistance to white blight' plot which were completely free from white blight and at the same time strong and healthy;

3. Plants growing in the 'resistance to white blight' plot which were completely free from white blight;

4. Plants growing in all other plots which were completely free from white blight;

5. Plants growing in all plots which were very strong and healthy but were slightly susceptible to white blight."

The final cob selections made after harvest follow the methods recommended to farmers for seed selection and are based mainly on freedom from and resistance to disease. Only the best seed, resistant to white blight and as far as possible also to *Fusarium* disease, is kept for further breeding on the rather small area available at the Scott Agricultural Laboratories. The remainder of the good seed is issued to seed farms in the native reserves which require this early maturing type of flat white maize. Mass selection is done on the seed farms from which seed is issued direct to native.

Muratha maize, already a high yielder compared with ordinary native maize, is thus being further improved with regard to disease resistance at the Scott Agricultural Laboratories, whilst its quality is being more than maintained by issues of good seed to the seed farms, where it is bulked, again selected and issued systematically to the natives. Observations made by Messrs. Halcrow and Gamble, by means of a field census, indicated that seed which had been selected for a number of years in succession for resistance to white blight showed some 50 per cent less infection than seed which had not been so carefully selected in this respect. Also they found that there was a definite correlation between a certain red colouration of the leaves and susceptibility to white blight, so that, during a season which was not favourable to the manifestation of white blight, selection against this red colouration may act as a good substitute for selection against white blight.

Muratha maize is a flat white type suitable for export and, owing to its earliness combined with high yielding ability, it is proposed to incorporate it in the 1935 maze seed

competitions at Njoro, Kitale and Rongai in order to give it a thorough comparative test for yield against all the other flat white types in common use amongst farmers. It is anticipated that Muratha should do well at Rongai and, if so, it should be of considerable assistance to the maize industry in that area, which is badly in need of a really early variety of maize. Such a variety would go far to minimise the effects of the frequent failure of the mid-season rains.

Maize Seed Competitions.

These competitions are run in conjunction with the Royal Agricultural and Horticultural Society of Kenya which takes a keen and useful interest in them and does much to popularize them amongst intelligent maize farmers. The success of the previous competitions resulted in a record of twenty-seven entries and involved a vast amount of work by the plant-breeding and agricultural staff at the different centres, as competitors had to enter for all three competitions at Njoro, Rongai and Kitale. Two rows, twelve yards long, of each entry were replicated twelve times at each centre. Continued propaganda and instruction are resulting in an appreciable levelling up in quality and yield of seed, but there is still a wide margin of yield between those who are at the top and bottom of the ranking list in each competition.

Owing to a six weeks' drought at a critical time in the growth of the crop and to torrential rains early in the season, the results at Kitale were not very outstanding but the winning seed yielded 13.88 bags per acre and the last 10.30 bags per acre, a difference of 3.58 bags per acre.

The Rongai district suffered from a serious drought and the winning seed only yielded 6.23 bags per acre and the last 3.35 bags per acre, a difference of 2.88 bags.

The best results were obtained at Njoro where the weather conditions were more normal. The winning yield was 11.45 bags per acre and the bottom but one yielded 7.12 bags. This is a difference of 4.33 bags. Put another way the winning entry yielded 60 per cent better than the last but one in the ranking list. The last only yielded 4.44 bags per acre. This was pure 8-row Hickory King which is not suited to the Njoro district.

It is of interest to note that at Kitale competitors from the district were in a distinct majority in the first half of the ranking list, at Rongai entrants from all districts were fairly equally represented in the first half but, at Njoro the

top half was almost entirely filled with local entrants. The indications are that, other things being equal, acclimatization is an important factor in certain districts. In the past the seed of certain competitors was amongst the last wherever it competed but now that more farmers are selecting their seed properly there is perhaps not sufficient difference between the dozen best to offset the acclimatization factor. Undoubtedly the competitions are having the desired effect of raising the standard of seed and seed selection. At present prices of maize there is not great scope for the sale of seed, but many farmers consider it worth while to go to the trouble and expense of entering the competitions in order to test the quality of their seed against that of other farmers and the Department's seed to see if they are selecting along the right lines. Every entrant has to grow fifty acres of maize with the same seed from which a random sample was taken for the competitions; in this way provision is made for every farmer to have enough good seed at least for his own farm and probably a surplus for sale as well. It is calculated that 5 per cent of the crop would be suitable for seed.

GENERAL FIELD INVESTIGATIONAL WORK.

A large amount of work of this nature is done on the Plant Breeding Station and all the staff joins in as it does with the specialized breeding and other work on cereals. For the sake of uniformity and other reasons I have thought it best however for an account of this work to be reported on separately by Mr. Ball, the Agricultural Officer of the Station, whose immediate responsibility it chiefly was. A new departure at the station was the institution of a small herd of twelve native in-calf heifers for utilization in grazing experiments, forage crop trials and silage trials. A number of small paddocks were fenced off for rotational grazing experiments and the necessary sheds put up. Native stock immune to East Coast Fever, were used because Njoro is a "dirty" area and no funds were available for a dip. Some of the heifers were in calf. It is hoped that the paddocks will be cleaned up after some two years of hand dressing of the cattle and that, should they all prove unsuitable for foundation breeding stock, better quality grade stock can then be substituted for them with a certain amount of safety and more comprehensive mixed farming experiments undertaken. It is hoped however that funds will become available for a dip later on.

G. J. L. BURTON,

Senior Plant Breeder and Experimentalist.

ANNUAL REPORT OF THE AGRICULTURAL OFFICER, PLANT BREEDING STATION, NJORO

The investigational work on crops and on soil fertility at the Plant Breeding Station, Njoro, forms a link in the chain of experiments conducted at Molo (9,000 ft.), Njoro (7,000 ft.) and Rongai (6,000 ft.), and is of course specifically designed to deal with conditions obtaining at altitudes of about 7,000 ft. with a rainfall in the neighbourhood of 35 inches. Such areas are not to be confused with those at an altitude of 7,000 ft. with two rainy seasons even though the total precipitation is about the same. Much of the experimental work done during the year was a continuation of that stated in previous years.

CROP TRIALS.

Two varieties of sweet corn have been tried out, viz. Golden Bantam and Squantum Corn. Both yielded very disappointing results, but the Squantum Corn is worthy of further trial. It should be planted in the early rains so that it may have set seed before the white maize has begun to flower. It appears to be a suitable corn for canning and should be multiplied for this purpose.

Marrowfat Peas.

Large plots of the three varieties, Harrison's Glory, Dutch Marrowfat and Japanese Marrowfat, which were the best of many tried in past years, were laid down with the object of comparing yields, and also of evolving some simple method of harvesting technique, based on the results of previous years' investigations, which would be suitable for the ordinary farmer. Two dates of sowing (early July and early August) were used, but the yields were rather low on account of the dry season experienced. The yields per acre of exportable peas are as follows :—

Japanese Marrowfat—447.9 lb. per acre.

Dutch Marrowfat—521.6 lb. per acre.

Harrison's Glory—313.7 lb. per acre.

As far as harvesting technique is concerned it appears that if the plants are harvested *in toto* when the bottom pods are commencing to yellow and all the material put straight into a maize crib or other suitable store, leaving a space at one end to permit of turning, slow drying will occur with the minimum amount of bleaching. The whole mass

should be turned every two to four days depending on conditions of moisture in the atmosphere outside, and drying takes about three to four weeks before the samples are fit to thresh. Results of grading of the threshed samples were as follows :—

			Bleached	Damaged	Whole
Harrison's Glory	..	..	2.7	15.5	81.8
Japanese Marrowfat	..	..	6.4	24.2	69.4
Dutch Marrowfat	..	..	12.3	5.4	82.3

Samples of the three varieties were forwarded through the Kenya Farmers' Association to Messrs. Mitchell Cotts & Co., Ltd., in England, who reported especially favourably on the Dutch Marrowfat sample quoting, in spite of very depressed market conditions in England, a price of £18 per ton C.I.F. The low price of £14 per ton C.I.F. was quoted for the Japanese Marrowfat. The Harrison's Glory was quoted at £17/5/0 per ton C.I.F.

In view of the higher yield and the good price obtainable it would appear that the Dutch Marrowfat is the most suitable variety for Kenya conditions and further, since a fairly simple drying technique has been evolved, it lies within the scope of many farmers to grow the crop. It is very important, however, to emphasize the fact that the acreage grown on any given farm must necessarily be limited to that for which storage facilities are available, when harvesting the crop. For these reasons, one cannot consider marrowfat peas in the light of a rotation crop in the sense that a sufficient acreage could be grown annually to cover the whole area of the farm in the course of a few years, but rather one must regard them as a crop whose cultivation will only be remunerative when conducted on a small scale.

Pea Inoculation Experiment.

An experiment was carried out on the use of an inoculum since marrowfat peas have always nodulated badly at Njoro. No significant difference was observed between inoculated and control plots, but some doubts were expressed as to the freshness of the inoculum used.

Linseeds.

The chief work with this crop during 1934 consisted of a statistical yield test of the eight varieties which had been grown in the previous year.

Further, four new varieties from Pusa were tried as well as two recent importations by the Kenya Farmers' Association named Morocco and La Plata for comparison with the strains of these two varieties already being grown.

All varieties were sown together on July 7th, seed rates varying from 32 to 73 lb. per acre, the drill being calibrated so that approximately the same number of seeds were sown per acre for the small seeded as for the large seeded varieties. The average rate was 45 lb. per acre. On October 11th the appearance of stem break disease (identified by the Senior Mycologist) in the variety Bison (40 per cent of plants destroyed) was observed which spread later to two other varieties, Bullmoose 4 per cent, and Persian Gulf $\frac{1}{4}$ per cent. There was no wilt disease observed at all in any variety.

Yields were low due to the exceptionally dry conditions and from the results it would appear that the three varieties Redwing, Persian Gulf and Morocco are most suited to Njoro conditions, and that the varieties Ottawa, Rio, Bison, La Plata and Bullmoose are not worth further trial.

	Yield Per Acre	Growth Period	Height
	<i>Lb.</i>	<i>Days</i>	<i>Inches</i>
Redwing	614.3	135	25
Persian Gulf	591.5	156	27
Morocco	541.9	156	21
Bullmoose	449.8	185	22 $\frac{1}{2}$
La Plata	441.0	186	17
Bison	353.5	183	21 $\frac{1}{2}$
Rio	283.5	186	19
Ottawa	260.8	183	20

Analysis of Statistical Results.

Redwing significantly greater than Bullmoose, La Plata, Bison, Rio and Ottawa.

Bullmoose significantly greater than Rio and Ottawa.

La Plata significantly greater than Ottawa.

The yields of the best varieties, although low on account of the drought, even at the existing poor prices would return a small profit to the grower, but it is doubtful whether a

large acreage under the crop would be justified owing to the difficulty of harvesting with a "combine" or other machinery. The chief use of the crop would appear to be for the stock farmer who can grow it as a food for calves or other stock, or alternatively for the wheat farmer on lands infected with "Take-all".

Pusas.

All these varieties yielded moderately well, but owing to the shortness of their straw would present difficulties in harvesting on a large scale. The varieties H.21 and H.38 are worth further trial to test whether acclimatisation will lead to increased length of straw and longer growth period.

K.F.A. Morocco.

This seed contained a percentage of late flowering tall growing rogues and does not appear as pure a strain as that grown previously.

K.F.A. La Plata.

This strain appeared identical with the similarly named variety already growing on the station.

Potatoes.

The experiments on this crop consisted of a Virus trial, with six different forms of Kerr's Pink, carried out under the auspices of the Senior Mycologist, a continuation of the variety trial (seven varieties), a manurial experiment, two trials to test the efficacy of the cultural practices as used for potatoes in this country and selection work amongst the Kikuyu native potato.

Virus Trial.

The results of this experiment were as follows :—

Varieties entered—

- A. Kerr's Pink non Virus Free (Njoro grown seed).
- B. Innishowen V.F.?—Njoro once grown.
- C. Gardiner V.F.?—Njoro once grown.
- D. Innishowen V.F.—Mau Summit.
- E. Gardiner V.F.—Mau Summit.
- F. Non Virus Free Molo.

Statistical analysis—

F, is significantly greater than A, B, C, D, E.

B, C, D and E are significantly greater than A.

D, is significantly greater than B.

Njoro grown Kerr's Pink has evidently degenerated badly due to virus diseases. The non virus free seed grown at a higher altitude has yielded the most satisfactory results. Innishowen virus free from Mau Summit is superior to similar seed once grown at Njoro, which suggests that deterioration due to virus has occurred after being grown once only at Njoro.

Variety Trials.

This experiment suffered throughout from the dry conditions and later from a very severe infestation of Early Blight which caused the haulm to die back prematurely. The native Kikuyu potato showed the most remarkable resistance to this disease, but in spite of this only occupied second place in the yield results. Kerr's Pink, although badly attacked, gave the heaviest yield. Spraying with Burgundy mixture was not possible since the disease first broke out during the only wet period in the growth of the crop, and the leaves of the plants in the early stages of infection were continually washed by the rain.

Kerr's Pink occupied first place in the trial with a yield of 2.37 tons per acre followed by Kikuyu Queen with a yield of 1.85 tons per acre. It is important to note, however, the very low percentage of ware potatoes in the case of the Kikuyu variety, and this further strengthened the case for the selection work that has been carried out in 1934 on this variety primarily with a view to the production of larger tubers.

Of the other varieties, Incomer (high percentage of ware) and Doon Star gave only moderate yields, while Allana, Great Scot and Golden Wonder are not worth further trial with existing stocks of seed. There is no doubt that the seed of all the varieties has degenerated badly at Njoro owing to virus disease (this fact being supported by results obtained in the virus experiment) and that regeneration is necessary either by the use of seed from higher altitudes or the importation of fresh stocks.

In view of the low export value of the crop at the present time, it would seem desirable that work should proceed along

the lines of the improvement of the Kikuyu potato by selection rather than that fresh stocks of the other varieties should be imported.

TABLE OF RESULTS

VARIETY	Yield Per Acre	PERCENTAGE		
		Ware	Seed	Chats
	<i>Tons</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Kerr's Pink	2.37	45.7	41.0	13.3
Kikuyu Queen	1.85	8.2	52.3	39.5
Incomer	1.69	50.9	41.0	8.1
Doon Star	1.39	33.7	52.7	13.6
Allanah	0.96	25.8	49.1	25.1
Great Scot	0.91	37.0	42.0	21.0
Golden Wonder	0.38	18.6	45.4	36.0

Analysis of statistical results showed that—

Kerr's Pink yielded significantly greater than Great Scot, Allanah, Doon Star and Golden Wonder.

Kikuyu Queen yielded significantly greater than Great Scot, Allanah and Golden Wonder.

Incomer yielded significantly greater than Great Scot and Golden Wonder.

Manurial Experiment.

This trial, which was carried out on Kerr's Pink, was planted on May 1st and was sprayed with Burgundy mixture three times against Early Blight which reduced the incidence of the disease very appreciably.

The manurial treatments consisted of Nitrogen (in the form of Sulphate of Ammonia) at the rate of 150 lb. per acre, Phosphate (as Superphosphate) at the rate of 250 lb. per acre, and a combined application of both these manures at the same rates.

Results were as follows :—

					Yield per Acre	Increase over Control
					<i>Tons</i>	<i>Per cent</i>
Control	..	..	..	..	1.94	—
Nitrogen	..	..	..	..	2.73	40.7
Phosphate	..	..	..	..	2.21	13.8
Phosphate and nitrogen	..	..	..	..	2.94	51.5

It will be observed, therefore, that almost the whole of the increase was due to Sulphate of Ammonia; the increase due to Phosphate not being sufficient to yield an economic

return either when applied alone or in conjunction with Sulphate of Ammonia. The following figures illustrate this point :—

			Cost per Acre	Yield Increase
			<i>Sh. cts.</i>	<i>Tons</i>
Sulphate of Ammonia	..	..	18 75	0.79
Superphosphate	..	..	17 80	0.27
Combined Application	..	..	36 55	1.00

Cultivation Trials.

It was considered that the normal cultivation practices in this country for potatoes are very inadequate, since they consist of little more than one cleaning and a final ridging. Even in this exceptionally dry year more frequent cultivations, breaking and reforming of the ridges gave an increased yield, in spite of the fact that the soil was more exposed to the effects of evaporation by these operations. Further trials along these lines are clearly indicated.

Selection of Kikuyu Potatoes.

Individual plant selections of Kikuyu potatoes grown from seed obtained from the Scott Agricultural Laboratories were made along the following lines :—

1. Size of tuber.
2. Number of tubers of ware grade.
3. Kidney or round types.
4. Resistance to Early Blight.

It would appear that this work is valuable since all the Kikuyu potatoes showed marked resistance to Early Blight and yielded well, their chief defects being that of uniformity to type and small size of tuber.

Barley Variety Trial.

A trial of four varieties of barley was carried out, and results showed definitely that Chevalier was most suited to Njoro conditions, this variety also being the quickest to mature. Results were as follows :—

				Yield per Acre	Period of Growth
				<i>Bags</i>	<i>Days</i>
Chevalier	..	..	..	7.72	120
Colsess	..	..	..	4.40	120
Regal	..	..	..	3.53	125
Spratt's Archer	..	..	..	2.53	160

Statistical Analysis :—

Chevalier yielded significantly greater than Regal, Colsess and Spratt's Archer.

Colsess yielded significantly greater than Spratt's Archer.

Although the shorter termed varieties were more favourably situated in a dry season, yet the results are sufficiently definite to indicate that Chevalier is the heaviest yielding variety under Njoro conditions.

Vetches.

Large multiplication plots of four varieties of vetches were laid down at two dates of sowing. Early sowing was found definitely to be preferable owing to the long growing period required by the crop.

Of the four varieties tried, Hairy, Woolly Pod and Purple were very promising. The Pearl variety made little growth and very poor cover and is not worth further trial. The Purple variety is about three weeks quicker than the Hairy, but tends to get coarse and woody in the later stages of growth.

As a cover crop for coffee or other permanent crop, the Hairy would appear to be the most suitable. Woolly Pod is of excellent feeding quality, but is too slow in the early stages to be ideal for inclusion in a fodder mixture, for which purpose Purple is definitely the most suitable on account of its quicker growth.

A large amount of seed of the three promising varieties has now been issued to farmers, Hairy sets seed very freely, Woolly Pod moderately well and Purple indifferently. The seed of all varieties is difficult to harvest owing to the uneven ripening which causes the bottom pods to shatter before the top ones are ripe.

Beans.

Canadian Wonder.—Plant selection has been carried out on this crop for resistance to bacterial blight. Plants were selected which scarcely showed the disease when the rest of the crop was severely affected. A mass selection of the more resistant plants was also made. It is impossible at this stage to tell whether this marked resistance to the disease exhibited by a few plants may not have been due to a slight difference

in rate of growth as compared with the rest of the plants in the field, and thus they may have escaped the period of infection. Further tests made next year should clear up this point.

Canning Varieties of Beans.—Fourteen varieties of beans suited for canning were tried, of which five were selected as being the most promising, both from the point of view of bacterial blight resistance and also yield. Growth of all varieties was poor but in spite of this they podded up well. The five most promising varieties were :—

Keeney's Stringless Green Refugee.

Stringless Refugee Wax N.170.

Refugee 1000 : 1 Stringy N.24.

Stringless Refugee Wax N.35.

Early Refugee Stringless N.173.

These varieties have, therefore, been tentatively recommended as being suited to the district for multiplication on a large scale for canning.

Horse Beans.—Four varieties of horse beans were tried and yielded extremely promising results. Their chief value would appear to be in the fact that they produce a protein rich food suitable for pig or stock feeding which could be grown cheaply on the farm. As a green manure they probably do not produce a sufficient bulk of green material to justify their growth on any extensive scale, but as a seed crop are definitely worth continued trial. The yields of all four strains, Ribayas 7, 8, 19 and 23, were sufficiently close for it to be impossible to recommend one in preference to any other at this stage.

Other Beans.—Small multiplication plots of Soya beans and ten other varieties of *Phaseolus vulgaris* were laid down, but results were not sufficiently important to justify further observation. The varieties Abundant and Dwarf Black Wonder showed fairly marked resistance to bacterial blight.

The Salmon Marled Lima bean showed promise as a drought resistant cover crop, although it suffered in the early stages from bacterial blight which at this altitude might destroy it completely in a wet season.

Pyrethrum.

A certain amount of breeding work was commenced in 1934, selected plants having been planted by themselves or in pairs together for crossing. In spite of repeated attempts,

it was impossible to obtain any viable seed from selfed plants; a number of crosses have, however, been made successfully.

Mass selection of seed in existing plots was also practised, based on number of flowers, earliness of flowering, size of flowers and duration of flowering period.

A nursery was established towards the end of the year for propagation of these crosses and seed selections and also for the purpose of obtaining planting material for experimentation on manuring, spacing, etc., in 1935.

Other Crops.

Rhamnus purshiana—Cascara.—This crop was transplanted early in the year from the nursery bed and has made good growth in spite of the drought. Some difficulty was experienced in establishing the plants due to the difficulty of removing them with the tap root intact. They should be transplanted when two to four inches high.

Artemisia maritima, Santonin.—This crop has grown well in spite of the drought and shows promise, although it is not the most suitable variety for the production of the drug. The variety *Artemisia brevifolia* is also being tried.

Chenopodium ambrosioides—Wormseed.—This crop has made little growth on account of the drought, but its oil content appears to be high and it is worth further trial.

Green Manure Crops.

Trials of four *Crotalaria*s were carried out but in every case germination was extremely slow and it is probable that under ordinary field conditions all would be too slow to compete with the growth of annual weeds which would completely smother them.

The varieties *Crotalaria grantiana* and *Crotalaria fulva* never made any appreciable growth, an unnamed variety from Nyasaland made fair growth, but the indigenous variety produced the greatest bulk of material.

Experiments on Seed Treatments.

Laboratory and field tests were carried out on the treatment of seeds of leguminous plants and grasses to hasten germination. The two chief treatments used were sandpaper and sulphuric acid. Increased germination was obtained in the local *Crotalaria* which in the field lead to the final production of 30 per cent more bulk than in the case of the untreated seed.

It was found that the sandpapering could best be performed by attrition between two sandpaper surfaces for ten to fifteen minutes. Sulphuric acid treatment consisted of steeping the seed for a period of ten to fifteen minutes in the concentrated acid, afterwards washing in water to free from the acid.

Mixed Farming.

Under this heading may conveniently be included all the work carried out on fodder crops, grasses and grassland during the year, also the newly established cattle enterprise.

Twelve native heifers, one calf and one bull arrived from Machakos on April 13th and since then three more calves have been born, two of which have been reared.

Improvement of the Veldt—By Management and Stocking.

As the result of one year's intensive grazing of the veldt with stock in small paddocks during a dry adverse season, the chief change that has been observed is the large increase in *Pennisetum schimperi* in the herbage and the decrease of Red Oat grass, *Themedia triandra*. Some doubt is, therefore, expressed as to whether it will be possible to improve the veldt in this area by grazing and management, as apart from ploughing and regeneration either naturally or by use of a mixture.

A section of the veldt has also been reserved for continued haying, three light crops of excellent hay having been made. Again on this area, as a result of repeated cutting, *Pennisetum schimperi* is increasing to the exclusion of the Oat grass, *Themedia triandra*.

It was considered also that the cattle should be used to obtain some measure of the stock carrying capacity of veldt pasture and its variability from month to month. Careful records were therefore kept of the number of cattle days on two-acre paddocks of unimproved veldt and the graph (see Appendix I) shows the great variation from month to month in stock carrying capacity. While there is no doubt that with the improvement of the veldt grazing, this capacity can be increased and the production of grass made more level throughout the year, yet there will always be certain months in the year when the capacity will be below average and it will be necessary to supplement with forage crops grown on arable land.

The chief need for such crops is, therefore, their ability to be stored in preparation for these dry periods or alternatively

that they themselves may be capable of standing over a dry period yielding an abundance of green material in the absence of rainfall.

Silage Crops.

Three mixtures were tried for silage :—

1. Oats and Peas : Sown in mixture, Algerian Oats 45 lb. per acre and P.B.I./P.50 peas at 65 lb. per acre.

This formed an excellent mixture although a slightly earlier oat would have been more advantageous for the peas were drilled three weeks after the oats. For this reason, also, a short term rye, locally named Klapprott, has been multiplied this year for use instead of oats in mixture with peas. As this variety does not produce a large amount of leaf, English Midsummer Rye has also been imported this year for trial. The yield per acre was heavy and at this station an oat and pea mixture would appear to be a more suitable crop for silage than maize.

2. Oats and New Zealand Grass Pea.—Oats 45 lb. per acre and New Zealand Grass Pea 30 lb. per acre.

The oats smothered the New Zealand Grass Pea and the final bulk obtained was low. This mixture is not worth further trial.

3. Oats and Purple Vetch.—Oats 45 lb. per acre. Purple Vetch 30 lb. per acre.

The Purple Vetch was practically smothered by the oats. A further trial should be given, sowing a lower seeding of oats and drilling the vetch about three weeks prior to the oats. The oats are only required to hold the vetches up and thus facilitate cutting.

Silage.

The quality of all silage made was excellent. Experiments were carried out with the use of $\frac{1}{2}$ to 1 per cent cane sugar molasses, watered in solution in the material to be ensiled. A very palatable light acid silage was produced with the minimum of waste, and this practise can be thoroughly recommended.

Kudzu Vine.

A few seedlings were obtained from the Scott Agricultural Laboratories for trial and some also were raised on the station. The crop has grown well in spite of the dry season.

Turnips, Mangolds and Swedes.

Several varieties of each of these crops were tried out, but damage in the case of the Brassicas by sawfly and a very poor stand in the case of the mangolds rendered yields so low as not to be worthy of consideration. The somewhat risky nature of these crops does not make them a commercial proposition at Njoro, when many other more suitable forage crops are available.

Kale, Rape and Cabbages.

Thousand-Head and Marrow Stem Kale grew fairly well in spite of the drought, but the growth of the cabbages was poor. Giant Rape suffered from Sawfly damage and the stand obtained was poor. The Kales appear the most suitable of these crops and their chief advantage lies in the fact that they are highly laxative and, if available in the dry season, tend to loosen the cattle which get constipated by the fibrous dry veldt grasses. It is doubtful, however, whether in this latter respect they are in any way superior to good silage or Hubam Clover.

Soya Beans.

Two varieties, Otootan and Ka-lu-a were grown, the latter being the more suitable for fodder as it produces a fair bulk of herbage and has an upright habit of growth. The chief disadvantage of these as fodder crops is the very severe depredations by buck, to which they are liable.

Other Fodder Crops.

Napier Grass.

(A) An imported strain obtained from Scott Agricultural Laboratories.—This grass was established from stools in spite of very dry conditions and yielded a heavy bulk of material for forage in the dry season. Although this station is probably near the upper limit for the growth of this grass, yet the heavy yields obtained make it a very promising crop.

(B) A Songhor strain.—This variety grows very slowly and does not appear to yield the same bulk of material as the other strain. It might, however, be more suited to higher altitudes.

Hubam Clover.

This is the most promising of the fodder crops for producing a bulk of fresh green matter during the dry season and also is not eaten by buck. Experiments in spacing of seed, cultivation and management of the crop, have been carried

out and results have shown definitely that the crop can be cut repeatedly providing it is not severed below six inches from the ground. A second cutting of the crop was made on January 8th and a third on January 29th in spite of the fact that no rain had fallen in the interval.

No difficulty was experienced in inducing the cattle to eat it, provided on the first day only a very dilute solution of molasses was sprinkled over it, after which they ate it with avidity.

This crop can now definitely be recommended to farmers as a dry season forage crop, but it should be emphasized that due care to cultural practices is of great importance for successful growth.

Cattle Carrot.

This crop showed promise as it stands well over the dry season, since it can be left in the ground and harvested as required. It is, however, relatively costly to grow as compared with the other forage crops.

Miscellaneous.

Small plots of Pampas Grass (*Gynerium argenteum*) and Edible Canna were planted, the former being highly palatable to cattle, but it was difficult to induce them to eat the latter. Both yielded satisfactorily in spite of the poor season.

Large Grass Plots.

Three large half- to three-quarter-acre grass plots were laid down with the following grasses: Indigenous Rhodes grass (*Chloris gayana*), Star grass (*Cynodon*) and Kikuyu grass (*Pennisetum clandestinum*). It is hoped to carry out grazing trials on these grasses with a view to comparing their stock carrying capacity. Growth has been poor on all due to the lack of rain. All were planted on land that had been previously in arable cultivation.

Production of Organic Manure.

The dairy stock has been used for the production of organic manure. The system in force is that the animals are night boma-ed and allowed to treat down as much wheat straw as possible, which is put in daily. It is calculated that each animal in this manner produces three or four tons

of dung per annum. The dung is removed every eight months when it is accumulated to a height of some four feet in the boma. It was found that in this manner the manure was secured in a reasonably moist condition. The requirements of the station for organic manure are satisfied.

Trial Plots of Grasses and Forage Plots.

Lespedeza and *Medicago denticulatum*.—Multiplication plots of three *Lespedeza* and *Medicago denticulatum* were laid down.

Medicago denticulatum.—This plant grows the most rapidly and seeds freely, but it is very short lived, for its period of growth is only about 169 days. The abundance with which it sets seed, however, leads one to expect that it might perpetuate in the veldt.

Perennial *Lespedeza*—*Lespedeza sericea*.—This plant has yielded disappointing results at Njoro. In spite of seed treatment, which has increased germination appreciably, it has been impossible to obtain a good stand, and growth both in the first and subsequent years has been very slow. The plant has never grown more than ten to twelve inches high, and it appears doubtful whether it would stand grazing on the veldt and it is definitely unsuited for a hay crop on account of the small bulk of material obtained. Furthermore it is extremely shy in setting seed, and propagation would be a very slow and difficult business.

Lespedeza striata var. Kobe : and Korean *Lespedeza*.—Both these varieties have about a twenty-day longer period of growth than *Medicago denticulatum* and they also seed fairly freely. The bulk of herbage produced, however, is very low and under veldt conditions it is doubtful in fact whether, with the grazing of cattle, they would be able to seed themselves, for the seed is in no way protected as in the case of *Medicago denticulatum* by a spiny coat which prevents the cattle eating the plant when in seed.

Trial plots of all the above varieties were also laid down in veldt pasture which was well scarified with harrows previously. All germinated well but unfortunately died out completely later with the exception of the *Medicago denticulatum* of which a few plants are still alive.

Grass, Clover and Lucerne Trial Plots.

Some ninety-nine trial plots of grass, clovers and lucerne, of which about twenty were continued from 1933, were laid down. The results obtained were briefly as follows :—

A. *Lucerne*.—Twelve varieties of lucerne were planted consisting of importations of either from Europe or Africa. The following varieties showed promise :—

1. Erect, quick growing—Hairy Peruvian.
2. Better stooling, slow growing—Provence, Grimm, Tagerim, Kansas Common and Montana.

It would appear that use might be made of some of these low growing varieties as possible leguminous pasture plants for their close habit of growth leads one to expect that they might withstand grazing successfully.

Ten large plots of Tagerim and Hairy Peruvian were also sown for the purpose of studying the best cultural practices, etc., for the crop. While the Hairy Peruvian was cut in the maiden year to prevent seeding, this was not necessary with the Tagerim variety. It was found that in spite of the fact that the land was clean prior to sowing and close inter-row spacing was adopted a certain amount of weeding with Plant Jr., hoes was necessary in the first year of growth.

B. *Grasses*.—These consisted of grasses imported from Europe, Australia and South Africa and also collections of indigenous grasses both from the neighbourhood and other areas.

The dry season emphasized the fact that the conditions of intense evaporation at Njoro do not suit the English grasses, which invariably wilt in the middle of the day with the possible exception of Red Fescue, this latter producing only a very small bulk of herbage. It seems highly doubtful, therefore, whether these grasses would stand grazing in this district and in any case there appears to be a fairly large range of indigenous and Australian grasses which combine the properties of drought resistance with the production of plenty of leaf material throughout the season.

Among the most promising of the imported grasses was the Australian strain of Rhodes Grass (*Chloris gayana*) which produced an abundance of leaf and only commenced to flower, and even then sparsely, at the end of the season. The bulk of herbage produced was nearly equal to three times that of

the indigenous strain. Other imported grasses worthy of mention are the Western Woth's and Wimmera Ryegrasses, both of which produced a heavy bulk of material in about eighty days; a bulk sufficient in fact to yield a hay crop of about thirty hundredweight per acre. Of the two, the Wimmera was slightly quicker but the Western Woth's was less wiry, this latter character being common to all the Ryegrasses. The particular use of these grasses in Australia would appear to be in the fact that they can be drilled in a wheat crop or other cereal and when the crop is harvested will grow and seed on the land. This was tried out at Njoro and the plants were established successfully in oats. After the oats were harvested, however, the grasses died out due to lack of moisture and to intense sunlight. This again seems to emphasize the fact that a nurse crop for grass or clovers is neither useful nor desirable under the conditions prevailing in this district.

Two other Australian grasses, *Bromus marginatus* and *Phalaris tuberosa*, produced an abundance of herbage of good quality throughout the season and appear suitable for inclusion in a pasture mixture. Also three strains of Western Grazier Ryegrass, *Agropyron tenerum*, were tried and showed marked drought resistance. *Paspalum dilatatum* grew well and showed drought resistance and would appear to be valuable for inclusion in a mixture for sowing down to grass as it has a low creeping habit which would aid in the formation of a sward.

Of the indigenous grasses tried, Kikuyu grass (*Penisetum clandestinum*), produced easily the greatest bulk of herbage throughout the year, the tendency of most of the others being to run into seed at an early stage, producing the minimum amount of leaf. *Sporobolus* spp., *Panicum maximum* and indigenous Rhodes Grass provided the most leaf under Njoro conditions. Molasses Grass (*Melinus minutiflora*) from the Kitale area was also very promising for it showed the greatest drought resistance of almost any grass, although somewhat coarse in character.

Other Leguminous Plants.

A large range of these plants were tried, including English Clovers, Subterranean Clovers, New Zealand Clovers, Birds-foot Trefoil and the indigenous white clover. As in the case of the grasses, the English clovers showed a tendency to wilt during the intense evaporation in the middle of the day and none showed any great promise.

It would appear that as leguminous plants for the veldt, New Zealand White Clover, *Trifolium johnstonii* or *Indigofera tettensis* are likely to be the most promising. The chief drawback to *Trifolium johnstonii* lies in its short period of growth but it sets seed very freely and would probably perpetuate itself in this way, provided soil conditions were favourable. *Indigofera tettensis* is very difficult to establish due to slow growth in the early stages, but appears drought resistant when once established.

Four acres of new land were broken during 1934 for sowing down during 1935 with grass seeds mixtures. Since many of the grasses under trial and observation have now been definitely shown to flourish under Njoro conditions it is possible to prepare mixtures for trial under actual grazing conditions, and to test out the ability of the indigenous and imported grasses to withstand heavy grazing. The provision of the leguminous element in the composition of these mixtures still remains the chief problem but it is hoped that some of the low-stooling varieties of lucerne already tried may prove useful in this connection.

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ANNUAL REPORT OF THE AGRICULTURAL OFFICER, NAKURU DISTRICT

The agricultural investigational work in the district is carried on at two centres besides the Njoro Plant Breeding Station which is situated at an altitude of 7,000 ft. These centres are Rongai (6,000 ft.) and Molo (9,000 ft.). The experiments therefore cover a wide range of climatic conditions and the results at Molo can be applied to most other districts where the altitude is between 8,000 ft. and 9,000 ft.

RONGAI.

Experiments at this centre, at an altitude of some 6,000 feet, are designed to deal with problems and crops in the rather low rainfall-high temperature areas of the Nakuru District. The plots are situated on the farm of Mr. J. E. A. Wolryche-Whitmore at Rongai and are fairly representative of these areas, there being only one season when rains can be said to be sufficiently good for planting, although in some years, which can be considered exceptional, there might be enough rain in the latter part of the year to enable a catch crop to be taken. The soil on these plots is of the Rongai pink type.

Experiment 1.

This experiment, a five-sided latin square, was continued from 1933 and was designed to test the frequency with which a green manure crop should enter into the farming system, and the effect which it has on the maize yields, when planted at one-, two-, three- and four-yearly intervals.

Madagascar butter beans were used as the green manure crop in 1934, but the maize indicator crop in 1934 followed cowpeas planted twice in 1933.

The maize was planted under exceptionally good conditions on May 5th, the method adopted being 36 in. x 36 in. check row planting. Growth on the plots which followed cowpeas in 1933 was outstanding up to the beginning of October, when drought caused premature ripening to take place.

Data obtained at harvest, when treated statistically, gave no indication that the preceding green manuring had benefited the maize crop.

The Madagascar butter bean used as the green manure in 1934 made very poor growth, being eaten down by cutworm three times before a good stand was obtained.

Experiment 2.

This experiment was designed as a modification of the Green Manure Randomized Block which formed part of the 1933 programme and comprised the following treatments:—

- (1) Madagascar butter bean ploughed under early.
- (2) Madagascar butter bean ploughed under as late as possible.
- (3) Madagascar butter bean as a cash crop.
- (4) Madagascar butter bean mulched and ploughed under as late as possible.
- (5) Maize control, ploughed late as is the usual custom in this district.
- (6) Maize left as long as possible before ploughing under.
- (7) White sugar bean as cash crop followed by a medium term green manure.
- (8) Weed fallow ploughed late in the season.
- (9) Clean fallow.
- (10) Sunflower ploughed in and followed by a weed crop.

Series No. 1, 2, 3 and 4 had to be planted three times owing to attacks by cutworm and made very poor growth.

The yield of maize on Series No. 5 and 6 was in the region of six bags per acre owing to the fact that it suffered badly from drought in the latter stages of growth. It is doubtful, in view of the poor growth of the green manure, whether it will be worth planting an indicator crop on this experiment in 1935.

Experiment 3 (Experiment 4 of 1933).

Maize was planted after Madagascar butter bean which had been treated in two ways in 1933. One plot had been mulched and the other ploughed under before seeding.

Yield of maize on the two plots was:—

<i>Mulched</i>	...	6.2 bags per acre
<i>Ploughed under</i>	...	6.5 bags per acre

It is doubtful whether the increase in yield would have been significant had the plots been replicated.

Experiment 4.

The Rongai section of the Seed Maize Competition was planted on May 2nd under ideal conditions, as three inches of rain had fallen in the previous week.

There were twenty-seven entries planted, each being replicated seven times. Each replication consisted of two rows, twenty yards long, two plants per hill and twenty hills per row. In addition two discard rows were planted at each end of the block.

Germination was good and damage effected by cutworm was only slight. The crop was adversely affected by drought in October and yields were disappointing.

Considerable differences were noticed in the resistance to *Fusarium* diseases, shown by the maize of the various competitors.

Results of the competition will be published together with those obtained at Njoro and Kitale.

Experiment 5—Crop Trials.

(A) *Linseed*.—Seven varieties of linseed were planted on May 4th in observation plots 10 yards x 3 yards in size.

Growth on all plots was extremely slow in the early stages of growth, but although the final yields were only moderately good, a great improvement took place after flowering.

The accompanying table gives the time taken for each variety to mature and remarks with reference to their suitability to Rongai conditions.

VARIETY	Maturity	Remarks
	<i>Days</i>	
Morocco ..	148	Poor yielder, short straw, grain pinched.
Persian Gulf..	148	Very similar to above.
La Plata ..	161	Very badly droughted owing to lateness.
Bull Moose ..	146	Good straw, fair yielder, grain pinched. 4.75 bags per acre.
Redwing ..	142	Good straw, even growth, small seed, plump grain, good yielder. 5.50 bags per acre.
Rio	148	Weak straw, poor yielder, unsuited to Rongai.
Ottawa ..	142	Good straw, very susceptible to drought, poor yielder, white seed. 3.50 bags per acre.

From the above results, Redwing would seem to be the variety most suited to conditions obtaining at this centre in 1934.

Morocco and Persian Gulf would have been difficult to harvest with machinery owing to the shortness of the straw.

No disease was observed in any of the varieties.

(B) *Marrowfat Peas*.—Large plots of the varieties Dutch Marrowfat and Japanese Marrowfat were planted on July 12th, with the object of trying out different methods of harvesting, in addition to obtaining yield data.

It had been found in 1933 that May planting was too early and that the July planting made excellent growth so this time of sowing was adopted for 1934.

The peas made good growth until the end of August, but no rain fell during the critical podding period, and the crop failed to set seed. Had the earlier date been adopted there might possibly have been better yields.

(C) *Beans*.—Eleven varieties of beans were planted in observation plots, in rows 1 foot apart. The seed rate varied from 40 lb. per acre for the small seeded varieties to 60 lb. per acre for the larger types.

The following data were obtained :—

VARIETIES	Days to Germination	Days to Flowering	Days to Harvest	Yield in Bags of 200 lb. per Acre
Japanese Otenashi ..	12	48	165	2.05
Roumanian Haricot .	12	48	165	1.93
Robust Pink ..	12	45	165	1.48
White Sugar ..	12	50	166	3.93
Basutoland Yellow ..	12	50	166	3.35
Victory	12	45	167	2.69
Bocchini	12	40	169	2.12
Brown Kidney ..	12	40	168	3.63
Canadian Red Kidney	12	40	188	2.98
Canadian Yellow-eye	12	48	167	3.63
White H. P. Haricot	12	50	167	3.15

The three white haricot beans Nos. 1, 2 and 3 of the table were very disappointing, but the variety White H.P. obtained from Mr. Whitmore was very drought resistant and fairly prolific.

White Sugar Bean was outstanding among the other varieties and suffered least from Bacterial Blight. This should be a good bean for use as a native food crop.

(D) *Groundnuts*.—Two varieties of groundnuts were tried, namely Virginia Bunch and Spanish Bunch. Neither of them made satisfactory growth and yield of seed was so small as to warrant this crop being regarded as unsuitable for the Rongai district.

(E) *Horse Gram*. (*Dolichos biflorus* and *Njahi* (*Dolichos lablab*).—Five varieties of the former and three of the latter were planted, these being the most promising of the twenty varieties of each species under trial in 1933. Judging by their performance at Rongai this year; not one could be considered suitable for either seed or green manure purposes.

(F) *Horse Beans* (*Vicia faba*).—Four kinds of Horse or Tick Bean from Egypt were tried, but were a complete failure.

Cereal Crops.

(1) *Wheat*.—A number of new varieties of wheat were tested out in conjunction with the Plant Breeding Section.

(2) *Barley*.—The number of varieties of barley under trial was twenty-three, four rows of each, each row ten yards in length, were planted for observation. Many consisted of varieties imported from Palestine and Greece.

Yields are given of those possessing good quality grain and straw, yielding capacity, and a marked resistance to Black Stem Rust.

VARIETY	Yield in Bags per Acre	Rust In- cidence	Remarks
Pal. 31 ..	13.45	Nil	Six-row, good straw, 18" high.
Pal. II. A..	17.00	Fair	Six-row, good grain and straw.
Pal. 15 ..	12.00	V. slight	Six-row, short straw, 15" high.
Pal. 35 ..	14.7	"	Six-row, fair grain, 15" high.
Pal. 36 ..	10.76	Nil	Ditto.
Pal. 41 ..	12.75	Nil	Two-row, very good grain and straw.
Greek. 5 ..	16.14	Slight	Six-row, good grain and straw, 24" high.
Greek. 12 ..	14.30	Slight	Six-row, good grain, strong straw.

The longer maturing barleys, namely Plumage Archer, Spratt Archer, Chevalier, Colsess and Regal, were badly hit by the drought in October–November and ripened prematurely.

(3) *Oats*.—Two varieties of oats, namely Biffen's Hybrid and Marvellous, were planted.

Biffen's Oat grew well and in a more favourable season it should prove a good grain-oat at Rongai.

Marvellous might be of value as a forage-oat.

Forage Crops.

(a) *Drumhead Cabbage*.—This was transplanted from seed beds at Njoro, it grew well to start with, but failed during the hot, dry weather.

(b) *Marrow-stem Kale*.—This crop made very poor growth and does not seem suited to this district.

(c) *Thousand-headed Kale*.—This proved the most drought resistant of the Brassicae tried at Rongai, growth at the end of the year from July planting was up to about three feet.

(d) *Giant Rape*.—Seed was sown at the rate of 8 lb. per acre, in rows two feet apart. Germination and growth were very poor.

(e) *Native Pumpkin*.—Only one plant was obtained, although twelve hills of two seeds were sown. Growth was very poor and the plant failed to form any fruit owing to attacks by Marrow Fly.

Grasses and Fodder Crops.

A short account is given, in tabular form, of the behaviour of each of the crops in this class, which were tried at Rongai in 1934.

SPECIES	Germination	Habit of Growth	Nodule Formation	Remarks
<i>Phalaris tuberosa</i> ..	V. good	Tufted, leafy ..	—	Not sufficiently drought resistant, better for high altitudes.
<i>Danthonia</i> spp. ..	V. poor	Sparse, all flowering culms ..	—	Not suitable, poor type.
<i>Bromus marginatus</i> ..	Good	Tufted, leafy ..	—	Rather coarse, fairly drought resistant, seeds fairly well.
<i>Chloris gayana</i> (Australian) ..	Fair	Prostrate, spreading, fairly leafy	—	Good hay type. Not so good as the indigenous strains from Kabete and Kitale.
<i>Chloris gayana</i> (Kitale Strain)	Good	Prostrate, leafy ..	—	Best of the Rhodes grass strains tried, drought resistant.
<i>Chloris gayana</i> (Kabete Strain)	Poor	Similar to, but more leafy, than Australian ..	—	Better grazing type than Australian strain.
<i>Amphilophis pertusa</i> ..	Fair	Semi-prostrate, sparse leaf ..	—	Grows well, but poor grazing type.
<i>Cenchrus ciliaris</i> (Erect) ..	V. poor	Erect, sparse ..	—	Herbage composed of flower stems, not suitable for pasture.
<i>Cenchrus ciliaris</i> (Prostrate) ..	V. poor	Prostrate, poor foliage ..	—	Poor cover, not worth further trial.
<i>Cynodon plectostachyum</i> (coarse strain) ..	V. good	Prostrate, rooting at the nodes ..	—	Very good cover and leafy herbage, easily the best grazing grass for Rongai.
<i>Cynodon plectostachyum</i> (fine strain) ..	V. good	Similar to the coarse, but much finer leaves ..	—	Almost equal to above, but not quite such a good cover and less leaf.
<i>Paspalum dilatatum</i> ..	Poor	Low, spreading ..	—	Appears unpalatable, well worth further investigation, growth quick.
<i>Agropyron tenerum</i> (3 strains)	F. to g.	Tufted ..	—	Obviously not suited to this altitude.
<i>Wimmera</i> Ryegrass ..	V. good	Tufted, luxuriant foliage ..	—	Will not persist under hot and dry conditions.
Western Wolths Ryegrass ..	V. good	As above ..	—	As above.
Teff Grass ..	V. good	Slender, erect annual ..	—	Made fair growth and worth further trial as hay crop.
<i>Panicum coloratum</i> ..	Fair	Erect, tufted ..	—	A hay type, worth further trial for this purpose.

SPECIES	Germi- nation	Habit of Growth	Nodule Formation	Remarks
<i>Brachiaria soluta</i> ..	V. poor	Procumbent	—	Good cover but herbage rather coarse, drought resistant, indigenous Rongai.
<i>Brachiaria platynota</i> ..	V. poor	Procumbent	—	Very drought resistant, looks unpalatable.
<i>Brachiaria brinzantha</i> ..	V. poor	Procumbent	—	Very fibrous appearance, drought resistant
<i>Setaria trinervia</i> ..	Poor	Erect tuft ..	—	Useless.
<i>Setaria aurea</i> ..	Good	Erect, sparse	—	Very inferior quality, no bulk.
<i>Melinis miniiflora</i> ..	Fair	Procumbent	—	Very drought resistant, heavy bulk, but looks a very coarse and inferior grass.
<i>Sporobolus filipes</i> ..	Fair	Erect, tufted	—	Useless, no bulk, discard.
<i>Panicum maximum</i> ..	Fair	Erect, leafy	—	Excellent hay grass, large amount of dry matter, seeds freely, drought resistant.
<i>Indigofera tetensis</i> ..	Nil		—	Fail to germinate.
<i>Trifolium johnstonii</i> ..	Fair	Low, creeping	Many, small	Did not persist in the dry weather.
<i>Lespedeza striata</i> (Kobe)	V. good	Erect, sparse	Few	Not a success.
<i>L. striata</i> (Japan Clover)	V. good	Small, prostrate	Few	Might make a good stop-wash crop for coffee in wetter district.
<i>L. stipulacea</i> (Korean Clover)	V. good	Similar to Kobe	Few	Inferior to variety Kobe.
<i>L. sericea</i> (Perennial) ..	V. good	Erect, sparse	None found	Very slow and difficult to establish, may need an inoculant.
<i>Trifolium resupinatum</i> ..	V. good	Small semi-erect ..	None discernable	Very small, annual, worth trying in pasture
<i>T. glomeratum</i> ..	—		—	Failure.
<i>T. cernuum</i> ..	—		—	Failure.
<i>T. alexandrinum</i> (3 varieties)	V. good	Erect, very little leaf ..	Few, large	Might do better in a wetter season or district.
<i>Medicago denticulatum</i> ..	Poor	Prostrate, spreading	Good	Worth trying in sub-tropical ley mixtures and for coffee stop-wash crop.
Lucerne Cossack ..	V. good	Low growing ..	None found	Stooled well, may be suitable for pasture.

SPECIES	Germination	Habit of Growth	Nodule Formation	Remarks
Lucerne, Montana Common	V. good	Semi-erect	None found	Good drought resister.
Lucerne, Hardigan ..	V. good	Semi-erect	do.	Slow and poor, not worth further trial.
Lucerne, Turkestan ..	Good	Prostrate, spreading	do.	Very good type for use in pastures, drought resistant.
Lucerne, Kansas Common ..	V. good	Semi-erect	do.	Poorish growth but drought resistant.
Lucerne, Tagerim ..	V. good	Semi-erect, heavy tillering	do.	Probably the best lucerne tried in 1934, subterranean crown.
Lucerne, Hairy Peruvian ..	V. good	Very erect, sparse leaf	do.	Good growth, high percentage of coarse stalks, poor hay.
Lucerne, Gumin ..	V. good	Small semi-prostrate	do.	Stools well, but very slow, not worth further trial.
Birdfoot Trefoil ..	Poor	Erect	—	Failed to grow more than two inches high.
<i>Melilotus alba</i> (Common biennial White)	Good	Low herbage, erect flower stems	Fair	Worth persevering with, slow.
Ditto Arctic ..	Fair	Low crown	Few	Not so good as above. Discard.
<i>M. alba, annua</i> (Hubam Clover)	V. good	Erect, woody	Few	Grew to 3'6" high in dense stand, should prove an excellent crop for Rongai.
<i>M. alba</i> Grundy Co....	Good	Low crown	Few	Poorest of Melilots. Discard.
<i>M. officinalis</i> 'Albotrea'	V. good	Low and bushy, dense leaf	Few	Yellow flowers, very much better type than Alba varieties.
Subterranean Clover ..	V. good	Prostrate	Good	Started very well but died out during dry spell. Try again.
Purple Vetch ..	V. good	Erect, poor coarse hay	Good	Best growth of vetches tried, should do well in a wetter year.
Pearl Vetch ..	V. good	Semi-erect	Good	Failed to survive the drought.
Monantha Vetch ..	V. good	Fine stems, Sparse leaf	Fair	Not sufficient bulk.
Woolly-pod Vetch ..	V. poor	Prostrate	Fair	Too slow, not so good as Purple Vetch.
Hairy Vetch ..	Fair	Prostrate	Good	Very good, better hay quality than Purple, drought resistant.

These plots were planted on May 3rd, conditions being ideal.

In addition to the above crops, a large multiplication plot of Rice Beans (*Phaseolus calcaratus*) was grown to obtain a supply of seed for green manuring purposes. This grew very well to start with but was badly dried up and it is doubtful whether any appreciable quantity of seed will be harvested.

The outstanding grasses were :—

A. For pasture work—

- (1) *Cynodon plectostachyum*.
- (2) *Chloris gayana*—Kitale strain.
- (3) *Chloris gayana*—Kabete strain.
- (4) *Melinis minutiflora*.
- (5) *Paspalum dilatatum*.

B. For hay crops—

- (1) *Chloris gayana*—Australian strain.
- (2) *Eragrostis abyssinica* (Teff Grass).
- (3) *Panicum maximum*.
- (4) *Panicum coloratum*.

Leguminous hay and fodder crops worth further investigation are :—

A. Hay crops.

- (1) Purple Vetch.
- (2) Hairy Vetch.
- (3) Hubam Clover.
- (4) *Melilotus officinalis* (var. Albotrea).

B. Green fodder crops.

- (1) Hubam Clover.
- (2) Purple Vetch.
- (3) Lucerne (var. *Tagerim*).
- (4) *Melilotus officinalis* (var. Albotrea).

C. Pasture legumes.

- (1) Lucerne (var. *Tagerim*).
- (2) Lucerne (var. *Cossack*).

- (3) *M. Alba* (var. Common Biennial White).
- (4) *Trifolium resupinatum*.
- (5) *Medicago denticulatum*.

Summary of Rongai Results.

The only thing which can be said about a season such as that experienced in 1934 is that it has clearly given any crops which are at all drought resistant, a chance to show up their capabilities in this respect.

Several crops which have behaved well under dry conditions in the previous year, were rather disappointing in 1934, and much seems to depend on the stage of growth reached by any given species or variety, when the rain ceases.

The time elapsing after the rain until the crops began to suffer was much shorter this year than in 1933, probably due to the fact that the amount of moisture in the subsoil is becoming exhausted.

Crops in general were very much below average in the Rongai Valley, although in the lower part towards Lower Molo, maize yields were above average. Wheat was a remunerative crop to most farmers and matures considerably quicker than maize.

There is a very marked tendency on the part of most farmers to turn over to a more mixed type of farming and in many, if not in all cases, the only consideration holding them back is the lack of capital.

At the meetings held at Mr. Toogood's farm and on the experimental plots at Rongai considerably increased interest in mixed farming problems was shown by those attending, and it is hoped that these meetings were of value to the district.

Several farms and estates have started to build up the fertility of the poorer *shambas* by the use of compost, the average cost of which works out at approximately Sh. 1/50 per ton if the job is done in a systematic way. In an area such as Rongai where the mid-season rains are somewhat uncertain it is probable that compost will provide the solution to organic manuring. Any green manuring attempted during such a season as the last would be an entire waste of time and money; it would, in fact, result in a considerable actual loss.

It is important that a statistical experiment should be laid down in 1935 to ascertain the optimum dressing of compost and the comparative value of compost and "boma manure". One case was noticed this year where an 8-ton application had resulted in extremely etiolated growth of the maize crop and a sudden wilting when the dry weather set in.

Experiments on Ngata Farm, Njoro.

Owing to the lack of response to green manuring by the soil on the Plant Breeding Station, Njoro, it was decided to transfer the existing experiments, or modifications of them, to a poorer type of soil in the district.

For this purpose a site was selected in the pipe line area at an altitude of about 6,850 feet. The soil is a dark coloured volcanic ash, has been cropped continuously for about twenty years and should therefore respond well to sound treatment for the improvement of the fertility of the soil.

Experiment 1.

This consisted of twenty-five plots in the form of a Latin Square, each plot measuring 11 yards x 11 yards, with paths and borders 2 ft. 6 in. wide.

This experiment was a replica of the Green Manure Latin Square at Rongai, except that the green manure used was New Zealand Grass Pea and the cereal, wheat, instead of maize.

Four series of plots were planted with New Zealand Grass Pea and the remaining five plots with wheat variety No. 112 E.8, these representing the control plots.

Both the peas and the wheat germinated well but owing to the drought, failed to make sufficient growth to warrant the experiment being followed up in 1936. It is suggested that a fresh start be made with the experiment next year.

Experiment 2.

This was a modification of Experiment 2 at Rongai, and consisted of 32 plots, these being made up of the following eight treatments each replicated four times.

The plots measured 11 yards x 11 yards, with 2 ft. 6 in. paths.

Treatment—

- 1 ... Wheat harvested and stubble ploughed under immediately.

- 2 ... Wheat harvested and stubble ploughed under late in season.
- 3 ... New Zealand Grass Pea ploughed under early in season.
- 4 ... New Zealand Grass Pea ploughed under late in season.
- 5 ... Barley headed and straw ploughed under.
- 6 ... Sunflower as green manure ploughed under.
- 7 ... Canadian Wonder Beans as a Cash Crop.
- 8 ... Weed fallow, left as long as possible before ploughing.

The same remarks apply to this experiment as to Number 1. Growth on all treatments was exceptionally poor, although planting was carried out in early July with the soil in a good moist condition.

It was unfortunate that the plots were not planted earlier but it was thought advisable to await really good rains before planting. These did not materialize until too late in the year.

MOLO.

Experiments at this centre, at an altitude of some 9,000 ft., are designed to deal with problems and crops in the high rainfall-low temperature areas of the country. The plots are situated on Marindas Farm belonging to Capt. Soames and Mr. Pell Smith, both of whom, besides providing the land, take a great interest in the work and provide considerable assistance also. The climate at these altitudes is temperate and they are well situated for growing wheat, pyrethrum, peas and intensive stock farming both with permanent pastures and with temporary leys alternating with wheat.

1. *Crop Trials.*

(a) *Marrowfat Peas.* (Harvesting Trials).—A large plot of Dutch Marrowfat Peas was planted on July 26th, the soil being in a good moist condition. The peas were sown with a Planet Junior Seeder at the rate of 112 lb. per acre and at depth of $1\frac{1}{2}$ inches, the rows being 16 inches apart. Germination was erratic and heavy rains immediately after planting caused a great deal of surface wash and much of the seed was carried completely out of the plot. The peas did not thrive and grew no higher than 8 inches and it was not possible to carry the experiment to a conclusion.

(b) *Linseeds*.—The following nine varieties of linseed were tried :—Redwing, Morocco, Persian Gulf, La Plata, Rio, Ottawa and Bull Moose.

The variety Redwing with a yield of 5.14 bags per acre was the best yielder, all the others being extremely disappointing. Bison suffered very badly from Stem-Break Disease. Growth throughout was most unthrifty and none of the varieties looked really healthy at any time.

(c) *Rye*.—Two varieties of rye were sown for observation and multiplication, namely :—Steel and a variety obtained from Mr. Klaprott.

The former, as in 1933, made very slow progress and formed a low dense mat which would be eminently suitable for sheep, either grazed or folded. Very little seed was set and this would appear to be the chief drawback to this variety, if it were to be used for sheep feed.

The second named variety grew very well, was quick and gave a fair yield of grain and a large bulk of straw.

(d) *Oats*.—A large multiplication plot measuring 40 yards by 70 yards of the Hybrid Oat obtained from Sir Roland Biffen was planted with the Planet Junior Drill at the rate of 40 lb. per acre. The yield was quite good and the grain of fair quality but contrary to expectations the crop was seriously infected with Stem Rust and lodged badly.

(e) *Miscellaneous Crops*. Planted July 4th :—

(1) *Marrowstem Kale*.—This grew very slowly and made very little bulk by the end of the year.

(2) *Thousand Headed Kale*.—The same remarks apply as for (1).

(3) *Artemisia maritima* (Santonin).—This grew very well from one years old transplants from Njoro and flowered in five months from planting.

If there is a remunerative market for the Santonin, this crop should be well worth growing at Molo.

(4) *Rhamnus purshiana* (Cascara).—One year old plants from Njoro were planted, these quickly recovered and grew well up to the end of the year.

Grasses and Clovers (1932).

The following grasses and clovers which were planted in 1932 survived until this year and several appear to be true long lived perennials, under Molo conditions.

(a) Grasses.

(1) *Cocksfoot. (Dactylis glomerata).*—This grass was cut twice during 1934 and gave an approximate yield of 1 ton of hay per acre at each cutting. Seed was produced freely, a slight attack of rust was noticed.

(2) *Timothy. (Phleum pratense).*—Very little dying out was noticed and two cuttings were made during the year. It is doubtful whether the growth of this grass for hay would be economic.

(3) *Italian Ryegrass. (Lolium italicum).*—This grass appears to behave as a perennial although there is a certain amount of volunteer seeding. Growth, as in 1933, was very heavy to luxuriant, and seed set very freely. Two cuttings of hay were made, when the grass was in flower and the yield was well over a ton per acre for each cutting.

(4) *Perennial Ryegrass. (Lolium perenne).*—This was not so good as the Italian Ryegrass and appeared to have become root-bound, it would probably behave much better under grazing conditions, particularly if clover could be grown in association with it.

(5) *Danish Meadow Fescue. (Festuca elatior, pratense).*—Heavier growth was made by this grass in 1934 than by Italian Ryegrass and it is certainly a more leafy type and should make very valuable hay.

(6) The remaining grasses planted in 1932 were very poor and made no progress during the year. These were Chewings Fescue, Hard Fescue, Crested Dogtail and Rough Stalked Meadow Grass.

These are all small, bottom grasses and would be of little importance at Molo.

(b) Clovers.

(1) *Red Clover. Var. Tennessee Disease Resistant.*—Although fairly persistent many plants died out during the year and the plot assumed a patchy appearance.

(2) *Subterannean Clover.*—Although quite a large number of self sown plants were seen in the plot, very poor growth was made and the plot was discarded.

(3) *Mammoth Red Clover*. (*Trifolium pratense*).—Growth of this species was better than No. 1, but it was not so persistent, and only a few plants survived to the end of the year.

(4) *Hubam Clover*. (*Melilotus alba* var. *annua*).—A full stand was again obtained from seed shed in 1933 and the clover reached a height of 4 ft. before flowering. The amount of frost occurring at this altitude, does not appear to do a great deal of lasting damage, and if the crop is affected by an occasional frost, it soon recovers.

This plant certainly gives a greater bulk of feeding matter than any other legume tried to date and is worth persevering with.

(5) *Birdsfoot Trefoil*. (*Lotus corniculatus*).—This crop like the Hubam clover gave an excellent stand from volunteer seeding in the third year. The ground was completely covered and the plants very effectively smothered all wheat growth.

The following were either discarded as being unsuitable or failed to persist.

(6) *Alsike Clover*. (*Trifolium hybridum*).

(7) *Dutch White Clover*. (*Trifolium repens*).

(8) *Biennial Sweet Clover*, (*Melilotus alba*.)

(9) *Melilotus officinalis*.

Summary of 1932 Plantings.

The most promising grasses were: Danish Meadow Fescue and Italian Ryegrass, whilst among the legumes Hubam Clover and Birdsfoot Trefoil were outstanding, by virtue of their ability to perpetuate themselves by self-seeding.

Grasses, Clover and Mixtures planted in 1933.

A. Grasses.

(1) *Cocksfoot*. (*Dactylis glomerata*).—The three strains of Cocksfoot from New Zealand planted in 1933 showed no differences that were sufficiently outstanding, to be seen by observation only. All persisted well and thickened out into a good sward. Very little flowering took place and the hay obtained from the two cuts made during the year, was of much better quality than that from the ordinary commercial strain planted in 1932. The portion of the plots sown under a nurse-crop could not be picked out from the other, by the end of the year.

(2) *Perennial Ryegrass*. (*Lolium perenne*).—Nine strains of New Zealand Perennial Ryegrass had been sown in 1933, as in the case of Cocksfoot, the halves of the plots sown under shade had caught up to the other halves by the end of 1934. The sward produced was of excellent quality and it is quite plain that a much lower seed rate would have given an equally good result. No difference could be seen in the individual strains, all were equally good for pasture purposes. It might be mentioned here that this grass is only likely to be of use for grazing and would not be either quick enough or sufficiently bulky, for either a true temporary-ley, or hay crop. The rapid growth after cutting is one of the most marked characteristics of this grass.

(3) *Brown Top*. (*Agrostis tenuis*).—This grass does not appear to thrive at Molo, even on the good soil of the plots, so it is unlikely to be of any value on the poorer soils, for which it was intended to use it.

(4) *Toowoomba Canary Grass*. (*Phalaris tuberosa*).—This grass, which was planted in the latter part of 1933, was obtained from Australia. Growth was extremely rapid and by the end of the year the grass had attained a height of 4 ft. 6 in. and was flowering heavily. A good quality of viable seed was almost ready for harvesting by the end of the year. The quality of the hay was poor and coarse and the habit of growth of the grass suggests that a mistake may have been made, by sending the seed of Reed Canary Grass (*Phalaris arundinacea*).

(B) *Clovers and Leguminous Food Plants*.

(1) *Red or Broad Red Clover*. *Trifolium pratense*.—This clover did not come up to expectations and made very slow progress, flowering had only just commenced at the end of the year, 17½ months after sowing.

(2) *Crimson Clover*. *Trifolium incarnatum*.—A good stand was obtained from the seed shed in the early part of the year, growth was very stunted and the plant does not appear to be suited to the Molo conditions. Liming of the soil might conceivably improve the performance of the crop.

(3) *New Zealand Wild White Clover*. *Trifolium repens*.—All that can be said of this plot is that it persisted until the end of the year, completely covered the ground and formed nodules freely. It is difficult to visualize this plant playing any part in pasture work owing to its inability to withstand competition and lack of vigour on the Molo plots.

(4) *Shaftal or Persian Clover. Trifolium resupinatum.*—Due to the small bulk of material produced and the annual character of this species, it is not likely to prove of any use at Molo.

(5) *Montgomery Late Flowering Red Clover.*—Growth of this strain of *T. pratense* was even slower than that of No. (1) and at 17½ months from sowing it had a poor stunted appearance and no flowering had taken place.

(6) *Berseem Clover. Trifolium alexandrinum.*—A few plants only appeared in the second year and these were so poor that further trials are not contemplated.

(7) *Subterranean Clover.*—Two strains were sown late in 1933, namely Dwalganup Early and Hackett's Late. The former was very much superior to either the latter or the commercial strain sown in 1932, and is certainly worthy of further trial.

(8) *Packet Sulla. Hedysarum corinarium.*—This plot was sown at the same time as No. (7). Only four plants germinated and these made excellent growth, flowered heavily and set seed freely. This crop would be very suitable for sheep folding, as a heavy bulk of fair quality material was produced. Much would depend on its palatability.

(9) *Lucerne Varieties.*—The varieties Hairy Peruvian and Tagerim were the most prominent of the seven under trial. Hairy Peruvian is undoubtedly the best yielder, but the hay produced is inclined to be coarse and "stemmy" and inferior in quality to that of Tagerim.

(C) *Grass and Clover Mixtures.*

All plots of Ley mixtures laid down in 1933 grew well in the year under review, but there was a marked tendency for the grasses to increase and the clovers to die out. This was particularly the case where Perennial Ryegrass was a constituent of the mixture as not only did it choke out the clovers but also the other species of grasses as well.

There was still a considerable amount of clover in evidence in the mixture made up as follows :—

Perennial Ryegrass	...	...	5 lb.
Timothy	...	...	8 lb.
Broad Red Clover	...	...	8 lb.

In the first year the vigorous growth of the Italian Ryegrass had smothered the clovers and the other grasses with the exception of Perennial Ryegrass, which came on in the second year and established itself at the expense of the surviving constituents of the mixture.

The types of clover tried at Molo were not sufficiently "at home" to compete successfully with the Ryegrasses. Unless a more vigorous type of legume can be found for Ley work at this centre, it seems that any attempt to establish a grass cum legume mixture will be a failure.

Italian Ryegrass, Meadow Fescue, or Cocksfoot, will give an excellent hay, folding or grazing crop for several years. Perennial Ryegrass would be eminently suitable for grazing purposes if the land had been thoroughly cleaned of perennial weeds and particularly Kikuyu Grass prior to sowing. Under Molo conditions Kikuyu Grass would not be likely to choke out Perennial Ryegrass for several years, but there would be a grave danger of the land becoming badly fouled if much of this grass existed in the *shamba* before the Ley was laid down.

(D) *Grasses, Clovers and Mixtures*, 1934.

The grasses and clovers planted in May 1934 had only just become established by the end of the year.

Available data are given in the following table :—

SPECIES	Germination	Habit of Growth	Nodule Formation	Remarks
ORIGIN DENMARK				
<i>Trifolium repens</i> ..	V. good	Small, creeping	Few, small	Poor.
<i>Trifolium pratense</i> 881	Excellent	Bunchy	Few	Good, slow.
<i>Trifolium pratense</i> 888	V. good	Bunchy	Few	Very good, better than 881.
<i>Medicago lupulina</i> ..	V. good	Prostrate, straggling	None visible	Very quick, may serve as Ley ingredient.
<i>Bromus arvensis</i> ..	V. good	Erect tufts	—	Poor quality, quick growth.
<i>Alopecurus pratensis</i> ..	Fair	Too small to say	—	Very slow, discard.
<i>Agrostis alba</i> ..	Excellent	Small, creeping	—	May be useful for poor soils.
<i>Avena elatior</i> ..	Fair	Erect	—	Quick, useful hay crop.
<i>Poa nemoralis</i> ..	—	..	—	Failure.
<i>Poa pratensis</i> ..	V. poor	..	—	Failure.
ORIGIN CANADA				
<i>Agropyron tenerum</i> ..	Fair	Erect	—	Very poor, discard.
ORIGIN S. AFRICA				
Teff Grass ..	Good	..	—	Failure at this altitude.
ORIGIN ENGLAND				
<i>Festuca elatior</i> ..	Good	Erect	—	Very quick, may be useful.
<i>Poa pratensis</i> ..	Good	Too early to say	—	Very slow.
<i>Festuca duruscula</i> ..	Excellent	Small erect tufts	—	No bulk, poor quality.
<i>Avena elatior</i> ..	Fair	Erect tufts	—	Very promising hay grass.
ORIGIN U.S.A.				
<i>Axonopus compressus</i> ..	Failed to germinate	..	..	..
Ladino White Clover	Good	Very small, too early to say	None seen	Healthy but small.
Timothy, Hay Type	Poor	Small, stunted	—	Not worth keeping.
Mammoth Red Clover	Fair	Bunchy	Few	Healthy, slow.
Bermuda Grass <i>Cynodon</i> spp.	Failed to germinate	..	..	..
<i>Bromus mollis</i> ..	Good	Erect, downy	—	Quick, fairly bulky but poor quality.
Lucerne var. Grimm ..	Fair	Too small to tell	None seen	Quick growth.
Timothy Welsh Pasture Type	Failed	..	..	..

Rate of Sowing of Wheat Experiment.

This experiment was laid down on Mr. A. W. Hemphill's farm at Mau Summit with the object of finding the optimum seed rate for sowing wheat under the conditions obtaining at this altitude.

The variety of wheat used was N.B. 230 grown on the farm and the seed was slightly above "fair average quality". Unfortunately no results were obtained as the wheat failed to mature on account of drought.

Large Scale Temporary Ley Plots.

Several half-acre plots of the most promising of the grasses and mixtures under trial in 1932 and 1933 were planted on Marindas Farm on July 27th.

These were :—

- (1) Italian Ryegrass at 5 lb. per acre.
- (2) Italian Ryegrass at 5 lb. per acre plus Vetch at 15 lb. per acre.
- (3) Italian Ryegrass at 5 lb. per acre plus Birdsfoot Trefoil at 2 lb. per acre.
- (4) Danish Meadow Fescue at 10 lb. per acre.
- (5) Cocksfoot at 10 lb. per acre.
- (6) Hubam Clover at 30 lb. per acre.

These were sown with a large force-feed wheat drill, the seed-rate being controlled by the insertion of wires into the hoppers of the drill. All feed tubes to the coulters were removed and the seed was scattered on the surface and was buried by the covering chains. Germination was fairly good on all plots but up till the end of the year growth was very slow. Useful information should be gathered from this experiment in 1935.

In addition to these plots, about 2 lb. of Wimmera Ryegrass was sown in an existing wheat crop at the rate of 2 lb. per acre, to endeavour to obtain a volunteer crop after the wheat was harvested.

No rain fell for several weeks after sowing and the seed malted and dried up.

TAKE-ALL EXPERIMENT—SAYER BROTHERS' FARM, MOLO.

An experiment designed to find out which, if any, of the indigenous grasses, or the grasses likely to be used in ley

mixtures, are able to act as hosts to the Take-all Fungus, was laid down, in collaboration with the Mycologist, on Messrs. Sayer Bros.' farm at Molo.

Each plot measured 6 ft. x 30 ft. and was separated from the neighbouring plots and the remainder of the field, by thickly planted rows of Broad Red Clover.

Half of each plot will be sown with wheat in 1935, and the remaining half in 1936, to show the effect of one and two years' rest on the incidence of Take-all.

The following species were used :—

(1) *Indigenous.*

TRANSPLANTED CUTTINGS OR DIVISIONS—

- (A) *Pennisetum schimperi.*
- (B) *Pennisetum clandestinum.*
- (C) *Eragrostis* spp.
- (D) *Themeda triandra.*
- (E) Italian Ryegrass.

SEEDS—

- (F) Perennial Ryegrass.
- (G) Wimmera Ryegrass.
- (H) Smooth-stalked Meadow Grass.
- (I) Cocksfoot.
- (K) Meadow Fescue.

Two other plots consisted of Bare Fallow and Clover respectively. All species germinated well and had become firmly established at the end of the year.

GRASSLAND MANURIAL EXPERIMENT—

MR. STEWART BELLHOUSE'S FARM, MOLO.

A plan of the lay-out of this experiment is given below.

The corners of all plots and sub-plots were marked with permanent cedar pegs before any manures were applied.

Good quality lime was applied to the plots on July 28th and the manures required for the other treatments is waiting on the farm and is to be distributed on the appropriate plots in January or February, 1935, so that the lime will have become thoroughly incorporated with the soil before they are put on.

Treatments will be as follows :—

1. Salt at 8 cwts. per acre.
2. Salt at 8 cwts. per acre plus lime at 2 tons per acre.
3. Lime at 2 tons per acre.
4. P.2.O.5. 200, K2.O 150, nitrogen 50. (all lb. per acre.)
5. As No. 4 but no nitrogen.
6. As No. 4 but no phosphoric acid.
7. As No. 4 but no potash.
8. No. 1, plus No. 4.
9. " 1, " 5.
10. " 1, " 6.
11. " 1, " 7.
12. " 2, " 4.
13. " 2, " 5.
14. " 2, " 6.
15. " 2, " 7.
16. " 3, " 4.
17. " 3, " 5.
18. " 3, " 6.
19. " 3, " 7.

Plots No. 20 to 26 inclusive are mechanical treatment of the grass-land super-imposed on Treatments 1, 2, 3, 4, 8, 12 and 16 respectively, while Treatment 27 is mechanical treatment of the ordinary 'veldt' such as that which constitutes the control.

LAY-OUT OF GRASSLAND MANURIAL EXPERIMENT, MOLO.

Plots unfenced and open to grazing.

27. MECHANICAL REGENERATION	20	1. Salt at 8 Cwt. per acre.			5½ yards.
	21	2. Salt at 8 Cwt. per acre, plus Lime at 2 tons per acre.			5½ yards.
	22	3. Lime at 2 tons per acre.			5½ yards.
	8	9.	10.	11.	5½ yards.
	23 1 and 4	1 and 5	1 and 6	1 and 7	
	16	17.	18.	19.	
	24 3 and 4	3 and 5	3 and 6	3 and 7	5½ yards.
	12	13.	14.	15.	5½ yards.
	25 2 and 4	2 and 5	2 and 6	2 and 7	
	4	5.	6.	7.	
5 yds.	26	No Nitrogen	No Phos.Acid	No Potash	22 yards.
	Phos. 200 Potash 150 Nitrogen 50 All in lbs. per acre.				
	2 yds. 9 yds. 9	11 yds.	11 yds.	11 yds.	

Surrounding "veldt" constitutes control.

NODULE FORMATION ON LEGUMINOUS PLANTS.

SPECIES	Rongai	Molo
1. <i>Phaseolus lunatus</i> Madagascar Butter Bean	Few, large ..	Not grown.
2. Marrowfat Peas ..	None discernible	Present but very small.
3. <i>Phaseolus vulgaris</i> ..	Plentiful ..	Not grown.
All varieties	Plentiful ..	Not grown.
4. Groundnuts, 2 varieties	Very few, small	Not grown.
5. <i>Dolichos biflorus</i> ..	Very poor ..	Not grown.
6. <i>Dolichos lablab</i> ..	Good, large ..	Not grown.
7. <i>Vicia faba</i> , Horse bean	Very few ..	Not grown.
8. <i>Trifolium johnstonii</i> ..	Many, small ..	Many on wild plants.
9. <i>Lepedeza striata</i> ..	Few, small ..	Not grown.
10. <i>Lepedeza stipulacea</i> ..	Few, small ..	Not grown.
11. <i>Lepedeza sericea</i> ..	Few, small ..	Not grown.
12. <i>Trifolium resupinatum</i>	None found ..	Many, minute on volunteers.
13. <i>Trifolium glomeratum</i> ..	Failure ..	Not grown.
14. <i>Trifolium cernuum</i> ..	Failure ..	Not grown.
15. <i>Trifolium alexandrinum</i>	Few, large ..	Not grown.
16. <i>Medicago denticulatum</i>	Many ..	Not grown.
17. <i>Medicago lupulina</i> ..	Not grown ..	None found.
18. Lucerne (all varieties)	None found ..	None found.
19. <i>Lotus corniculatus</i> ...	Failed ..	Many, large.
20. <i>Melilotus</i> (all species) ..	Present, few ..	Not grown.
21. <i>Trifolium subterranean</i>	Good ..	Fair.
22. Vetches (all species) ..	Fair to good ..	Many on self-sown plants.
23. New Zealand Grass Pea	Hardly visible	Not grown.
24. <i>Trifolium pratense</i> ..	Not grown ..	Present but not plentiful.
25. <i>Trifolium repens</i> ..	Not grown ..	Plentiful.
26. <i>Trifolium incarnatum</i> ..	Not grown ..	Few only.
27. <i>Hedysarum coronarium</i>	Not grown ..	Plentiful.
28. Ladino White Clover ..	Not grown ..	None seen.

I should like to express my appreciation of the help received throughout the year from the following :—

(1) Mr. J. E. A. Wolryche-Whitmore, for the use of the plots on his farm and the help given in providing *posho* for the labourers, and in many other ways.

(2) Capt. C. T. Soames and Mr. H. Pell-Smith for the use of the land on Marindas Farm, Molo, and the supervision of labourers engaged on the experimental plots.

(3) Mr. Stewart Bellhouse for providing land and labour for the grass manurial experiment on his Molo farm.

(4) Mr. Hugh Coltart, Farm Manager of Lord Egerton of Tatton's Njoro farms, for land and labour for the green manuring investigations on the Pipe Line at Njoro.

(5) Messrs. Sayer Bros. and their Manager, Mr. C. A. Thornton, for help in establishing the Take-all experiment at Molo.

(6) The Molo-Mau Summit Farmers' Association for financial help towards the upkeep of the Molo plots.

R. J. BENSTEAD,

Agricultural Officer.

REPORT OF THE AGRICULTURAL OFFICER, KITALE, ON INVESTIGATIONAL WORK

The investigational work in the Trans Nzoia-Hoey's Bridge district has been conducted both on a number of farms and on the Central Plot belonging to Government. There were two reasons for this; the first because of the desirability of soil fertility experiments being conducted on each of the main soil types in the district, and the second because a number of long range experiments had already been started before the Central Plot came into existence. The nature and situation of the experimental work is listed below:—

Sabwani Estate, Kitale (Estates and Investment, Ltd.)—Green Manure Rotational Experiment. (Five-sided Latin square).

J. F. Gilson, Esq., Wywurrie, Kama Koia.—Green Manure Rotational Experiment (Five-sided Latin square).

L. A. Elmer, Esq., Maboonde, Kitale.—Green Manure Rotational Experiment (Five-sided Latin square). Maize Seed Competition (28 entries replicated in 12 blocks).

Cardale Luck, Esq., Kitale.—Crop Trials.

Central Plot, Kitale (Experimental Farm site).—Coffee Variety Trials, Shade Tree and Cover Crop Trials, etc. Pasture Trials (Paddocking). Pasture and Forage Plant Trials. Forage Crop Trials. Pyrethrum Trials.

Geoffrey More, Esq., Onekana, Kitale.—Inter-planting of maize with green manures (62 rows 6 ft. apart, 80 yds. long). Green Manuring Methods—Experiment (6 treatments, 6 replications).

Barnes Bros., Westlands, Hoey's Bridge. (Work carried out by the owners).—Green Manure Rotational Experiment (Five-sided Latin square). Green Manuring Experiment (6 treatments, 6 replications). Inter-planting of maize with green manures. (Single rows 6 ft. apart, double rows 1 ft. apart, with 12 ft. intervals.)

(a) Crop Trials.

Njahi (Dolichos lablab).

Twenty bush varieties were imported in 1933 from the Madras Presidency and were planted in 1/20th and 1/10th acre plots on the farm of Cardale Luck, Esq., on July 23rd,

1934. The year was most favourable to Njahi, a dry September succeeding a wet August, and bacterial blight was not troublesome with the exception of on the late maturing varieties which yielded very little seed. Njahi planted in the latter half of the year is a very useful green manure crop in the Trans Nzoia, when buck permit of its use, being drought resistant and throwing out fresh green leaves with the first rains before being ploughed under in February or early March. Seed of excellent quality was harvested and it is hoped to continue with some of these bush varieties for the purpose of interplanting maize planted in rows 6 in. apart. Some of the seed samples were slightly weevily and the seed was rather old, which accounts for the poorer stands and yields. It seems probable that with a good stand at least eight to ten bags an acre could be expected.

TABLE I
DOLICHOS LABLAB

No.	DISTRICT	Flower Colour	Seed Colour	Seed rate per Acre	(Planted 23rd July) Yield per Acre	Height of Plants	Stand Estimated
				Lb.	Bags	Ins.	%
1	Vizagapatam	Purple	Black	20	3.2	18	50
2	Kistna ..	White	Khaki	40	4.0	19	80
3	Cuntur ..	Purple	Black	40	6.0	16	80
4	Cuntur ..	White	Khaki	40	6.0	16	70
5	Chingleput ..	White	Khaki	40	6.0	11	60
6	Chittoor ..	White	Khaki	50	7.0	16	70
7	Chittoor ..	White	Buff	40	5.6	17	60
8	North Arcot	White	Buff	40	5.6	17	40
9	North Arcot	White	Khaki	40	5.9	17	65
10	North Arcot	White	Chocolate	40	4.6	16	50
11	South Arcot	Purple	Black	40	6.8	15	70
12	South Arcot	White	White	40	0.4	15	5
13	South Arcot	White	Buff	40	4.0	16	15
14	Trichinopoly	White	White	40	1.2	19	10
15	Trichinopoly	White	Buff	40	2.8	16	10
16	Madura ..	White	Buff	40	5.0	16	40
17	Madura ..	Purple	Black	40	5.6	17	50
18	Tinnevelly ..	Purple	Black	30	4.3	17	60
19	Malabar ..	White	Buff	40	2.0	14	1
20	Coimbatore.	White	Khaki	40	4.8	14	30

Horse Gram (Dolichos biflorus).

Twenty varieties of this crop were also obtained from Madras. This crop is not bulky enough for use as a green manure and its application is likely to be as a food crop in native areas at a low altitude and with a small rainfall. It

is extremely drought-resistant but suffered from mildew in 1934, at an altitude of 6,100 ft., after moderate rains had fallen.

TABLE II
DOLICHOS BIFLORUS

Nos. 1-13 PLANTED 24TH JULY, Nos. 14-20 PLANTED 25TH JULY

No.	DISTRICT	Date Harvested	Seed Rate Used per Acre	Yield per Acre	Height of Plants	Stand Estimated
			<i>Lb.</i>	<i>Bags</i>	<i>Ins.</i>	<i>Per cent</i>
1	Vizagapatam	17th Dec.	40	2.30	7	90
2	Vizagapatam	17th Dec.	40	0.20	6	Under 1
3	Kistina ..	28th Dec.	40	1.74	10	90
4	Guntur ..	27th Dec.	40	0.94	10	90
5	Nellore ..	27th Dec.	30	1.20	9	80
6	Kurnool ..	28th Dec.	60	1.23	10	95
7	Bellary ..	29th Dec.	40	1.68	9	85
8	Cuddapah .	29th Dec.	40	1.18	10	85
9	Cittoor ..	29th Dec.	40	1.18	9	90
10	North Arcot	9th Jan.	60	0.64	9	90
11	South Arcot	24th Dec.	40	0.98	9	95
12	Chingleput .	22nd Dec.	40	1.32	8	85
13	Trichinopoly	21st Dec.	40	1.00	9	80
14	Madura ..	21st Dec.	40	1.15	9	80
15	Tinnevely .	17th Dec.	40	0.95	9	85
16	Tinnevely .	17th Dec.	40	1.81	8	60
17	Tinnevely .	19th Dec.	40	0.95	9	70
18	South Kanara	18th Dec.	40	1.09	8	90
19	Malabar ..	18th Dec.	40	0.88	9	90
20	Coimbatore.	20th Dec.	40	0.54	9	90

Groundnuts.

The following varieties of groundnuts were grown on very small plots:—

Kanno	Indian	Spanish Bunch
Zanzibar	Jumbo	Virginia Bunch

At this altitude (6,100 ft.) the nuts take nearly seven months from planting to harvest. These were planted on July 24th, 1934, and harvested on February 13th, 1935, but they might have been left a week or more longer in the ground. Buck and rabbits nibbled the plants severely, despite the wire netting which had been placed round the plots in the effort to keep the animals away and the actual yield of one or two bags per acre cannot be taken as representative of yields which might be obtainable under more favourable conditions. This year the groundnuts were spaced 6 in. apart each way and, whether or no this was the reason for escaping the disease, no "Mosaic" appeared as in 1933.

Dutch Marrowfat Peas.

A one-eighth acre plot of Dutch Marrowfat Peas suffered very much from the drought in September. The peas were planted on July 24th and harvested on November 1st, yielding only 2.4 bags per acre.

Linseeds.

Several 1/20th acre plots were planted of various varieties on the 6th and 7th July and four very small plots of Pusa hybrids on 23rd July.

Owing to various cultural difficulties there was a considerable sprinkling of seedling weeds on the plots when the linseeds were planted and heavy rains during July and August prevented the control of the weeds after planting, which had been anticipated. Undoubtedly weeds were one factor involved in the poor yields obtained and the plots made an object lesson of the need for sowing linseeds on an absolutely clean seed-bed, procured by several tooth-harrowings preceding the planting.

After exceptionally heavy rain in August a virtual drought succeeded in September and doubtless lack of nitrification succeeded extreme leaching and water-logging to the considerable detriment of the growth and yields of the linseeds. Yields are only based on the produce of single plots but it appears that the quicker maturing, short strawed, Indian varieties were best suited to the climatic conditions which occurred in 1934. On the other hand, the lengths of the growth periods of the slower-maturing varieties were doubtless increased by rains which fell in December.

VARIETY	Yield per Acre	Growth Period	Height
	<i>Lb.</i>	<i>Days</i>	<i>Inches</i>
La Plata.. ..	136	198	29
Persian Gulf ..	169	173	30
Morocco	197	185	24
H. 13	200	119	15
T. 12	240	119	16
Bombay	500	119	13
Calcutta	480	119	12
Pusa Hybrids—			
L.H. 21 ..	346	103	13
L.H. 38 ..	415	103	15
L.H. 55 ..	314	103	11
L.H. 68 ..	415	103	13

Horse Beans.

For the same reason two 1/20th acre plots of Horse Beans planted on July 25th were a complete failure.

(b) Soil Fertility Experiments in connection with maize growing.

The Green Manure Rotational Plots gave good results at all centres in 1934.

YIELD OF MAIZE IN 1934

PLOT	CONTROL		GREEN MANURE 1933		GREEN MANURE 1931		STANDARD ERROR	
	Bags per Acre	Per cent	Bags per Acre	Per cent	Bags per Acre	Per cent	Bags per Acre	Per cent
J. F. Gilson, Kama Koia	8.90	100	12.37*	139.0	8.01	90.0	0.70	7.88
L. A. Elmer Kitale	1.96	100	5.83	297.1	2.79	142.8	1.23	62.88
Sabwani Estate .	16.28	100	22.06*	135.5	17.70	108.7	0.58	3.32
Kitale Barnes Bros. . .	14.12	100	19.50*	138.1	15.93	112.8	0.67	4.75
Hoey's Bridge	—	—	G.M. 1932	—	16.16	114.4	—	—

*A statistically significant increase over the yield of the control (continuous maize) plots.

The plot on Mr. Elmer's farm gave a surprisingly low yield, which can only be attributed to the effect of an unfavourable season coupled to that of sheet erosion consequent on continuous maize growing for fourteen years.

The maize was planted on April 16th and suffered from heavy rains in April and May. Some of the maize on the control plots only grew 18 in. high. Ten or twelve inches of rain in August followed by a drought in September completed the ruin of the crop, though the right hand column of four plots on higher, better land, which presumably has not washed so much, yielded an average of 10.48 bags per acre. The control plots in the other four columns yielded 16½ lb., 9¼ lb., 2½ lb. and 13½ lb. of wet maize on 1/20th acre. Four other yields were nil, ⅓ lb., 3½ lb. and 6½ lb. off 1/20th acre plots.

The green manure latin squares at Elmer's and Barnes' Bros. are being continued with, whilst those at Sabwani

Estate and Gilson's are being closed down. The former, which is on a rich volcanic loam on a flat plain where the wash is slight, has already given the necessary results; the latter is now showing signs of deterioration after eight years cultivation and erosion may be expected to increase in severity from now on. The unevenness of the land on this site, for no apparent reason, is exemplified by the fact that one of the control plots has yielded an average of 14.4 bags per acre over the past four years, while another with similar consistency throughout, has yielded an average of 7.4 bags. This unevenness has, previous to 1934, rendered it impossible to show a *statistically significant* increase from green manuring on the Latin Square.

Green Manures Interplanted in Maize.

The object of these experiments is to find out whether the system of green manuring by inter-planting green manure crops between widely spaced rows of maize will prove a more economic method of green manuring than the system of devoting a portion of the land every year solely to a green manure crop. Much depends on the yield per acre of the widely spaced rows of maize and on the growth of the green manure crop between them. Previous experiments have shown what was the best inter-row spacing for the maize in order to obtain a good yield and that the minimum inter-row spacing for maize necessary to obviate too great shading of the green manure crop was six feet. The abundant rainfall usual in the Trans Nzoia district should give this method of green manuring every chance of being successful.

Two acres of maize were planted in rows six feet apart on Mr. Geoffrey More's farm on May 3rd. Two seeds were planted per hill in the row, each hill being twelve inches apart. Alternate rows were thinned out so as to give stands of 10,770 and 7,120 plants per acre in unthinned and thinned rows respectively. The corresponding yields were 12.58 and 11.40 bags per acre respectively.

On August 1st Velvet Beans, Soya Beans, and Lupins were planted in between the rows of maize, and *Crotalaria kirkii* on August 2nd—ten "plots" for each crop. Cowpeas were drilled on August 31st. Some plots were left bare. Five plots of each green manure were dug in (to represent early ploughing) on December 6th, and the rest will be ploughed under in March. Lupins and Soya Beans made very poor growth. The best crop by far was the Nandi

Cowpeas which grew 14 in. high and constituted about a 70 per cent cover by December 6th. Unfortunately buck broke over the wire later on and demolished this crop where it had not been dug in. The *Crotalaria* was moderately good. The Velvet Beans were also promising but they tend to climb up the maize; however, the *Stizolobium* spp. are very drought-resistant and make fresh growth with the early rains.

Maize will be planted in the interspaces of the 1934 rows in 1935.

A similar plot at Messrs. Barnes Bros. farm at Hoey's Bridge gave 15.80 bags an acre from maize planted 6 feet apart and 13.19 bags an acre from maize planted two rows together, 1 foot apart, followed by a 12-foot inter-space for green manuring. Owing to an unfortunate lay-out of these two plots, however, by which the 6-foot spacing blocks were lower down the slope than the 12-foot blocks, it is questionable whether the difference in yields is not due to a difference in soil fertility rather than to the superiority of the 6-foot spacing; the experiment is worthy of repetition. At the same time the climatic peculiarities of the Hoey's Bridge area render it somewhat doubtful if this method of green manuring maize land will ever prove to be feasible in that district.

An experiment was carried through the preparatory stage in 1934 at Mr. More's and Messrs. Barnes' farms, which is designed to give information in 1935, when maize will follow, as to the best method of carrying out ordinary green manuring. There are six plots, randomised, of each of the following treatments :—

1. Control : Maize.
2. Sunflowers followed by lupins, ploughed 1934.
3. Sunflowers followed by lupins, ploughed 1935.
4. Weeds followed by lupins, ploughed 1934.
5. Weeds followed by lupins, ploughed 1935.
6. Weeds followed by velvet beans and lupins, ploughed 1935.

As regards plots 4, 5 and 6, it is evident that on poor land wash is encouraged by not planting a crop early in the year when green manuring is practised, since the growth of weeds alone is not adequate to cover the soil.

(c) *Coffee Experiments.*

Coffee Varieties.

More varieties were added to the trials during 1934, several of them through the kindness of Mr. J. W. Newton, Murogosi Nurseries, Turbo, viz. :—

Kenya Selected (Series D).

Plateau Bronze.

French Mission : Coldham's Selection.

French Mission Bronze-tipped.

Blue Mountain (Imported).

Kent's Hybrid (Indian selected seed imported).

Shade Trees.

The following were added through the generosity of Mr. J. W. Newton, Esq., Murogosi Nurseries, Turbo, and F. C. Jack, Esq., Mount Elgon Nurseries, Kitale :—

Solanum robustum.

Croton megalocarpus.

Cedrella toona.

Erythrina kaffra.

Vitex keniensis.

Ficus sp. (raised from seed supplied by J. Howard, Esq., Cherangani).

“Ober” (from Gem, Central Kavirondo).

In addition some of the trees used in the mixed shade planted in 1933 were repeated in small blocks of six trees of a single species planted in 1934.

Temporary Shade.

As well as repeating some of the temporary shade trees planted in 1933 the following were planted :—

Castor Oil.

Calpurnia aurea.

Indigofera erecta.

Tephrosia sp. from Kiambu.

Artificial Shade.

A small piece of artificial shade covering about sixty trees was erected at the end of 1934. I was enabled to do this through the generous gift of red thorn posts by Messrs. Swann & Perkins, of Teldet Estate, Mount Elgon.

Green Manures and Cover Crops in Coffee.

The following are now well tried or established, having been planted either in 1933 or 1934 :—

Tephrosia vogelii.

Tephrosia rigida.

Tephrosia candida.

Tephrosia sp. (Kiambu).

Stizolobium aterrimum (Back Mauritius Bean).

Vigna sp. (indigenous).

Phaseolus multiflorus (White Runner Bean).

Phaseolus lunatus (Purple and White Mottled Lima Bean).

Phaseolus lunatus (Salmon Marled Lima Bean).

Crotalaria kirkii (Nakuru).

Crotalaria alata.

Vicia villosa (Hairy Vetch).

Vicia atropurpurea (Purple Vetch).

Medicago denticulata (Burr Clover).

Melilotus annua (Hubam Clover).

Lupinus termis (Teneriffe Lupin).

Medicago sativa (Provence Lucerne).

Lespedeza stipulacea (Korean Lespedeza).

Cajanus indicus (Pigeon Pea : "New Era").

Calopogonium orthocarpum.

Pueraria javanica.

Centrosema plumieri.

Centrosema pubescens.

These green manure and cover crops are doing splendidly and at present an embarrassing choice is presented to the planter who wishes to carry out green manuring or to plant a cover crop. A great many planters have inspected these crops amongst the coffee and more interest has been shown in this work than in any which I have carried out in and around Kitale hitherto. It will be possible to issue a large number of packets of seed for trial to local farmers during 1935.

Mulching.

The two plots mulched with veldt grass have been in excellent condition throughout the dry weather. One plot is kept continually under a mulch, which is turned over in

July and replenished in October, while on the other the grass is raked into rows at the beginning of the rains and a crop planted which is cut in October, more grass being added to cover the ground again during the dry weather.

Vertical Forking.

All trees planted in 1933 were forked around with plantation forks in July 1934.

Anthracnose and Coffee Berry Disease.

The continued increase in the district of the amount of die-back of coffee, formerly known as "Elgon Die-back" but which has appeared during 1934 on several sandy-soil farms in the Trans Nzoia also, which was mentioned in my report for 1933, necessitated the establishment of investigational work based on the experiment. After joint discussion in March with the Senior Coffee Officer and the Mycologist, I drew up an experimental programme to be carried out on General H. K. Jackson's farm, Kapretwa, Mount Elgon, as a complement to work in progress on the Experimental Farm at Kitale. The experiment involved variety trials, shade and other cultural measures, such as spraying, fertilising, vertical forking, etc. Later in the year I proposed a plan for the use of different methods of vegetative propagation as a means together with variety trials, of combating the die-back and Coffee Berry Disease. Mr. E. D'Olier, of Endebess, was to assist in this work on his farm also, while selection of disease resistant trees was to be carried out by as many farmers as possible. At the end of 1934 Mr. Thorold, Mycologist, was posted to Mount Elgon, and this work is now under his immediate supervision.

(d) Pastures and Forage Crops.

Trials of Grasses and Leguminous Pasture and Forage Plants.

The grasses, clovers, etc., which were grown during 1932 and 1933, near the office of the Department of Agriculture at Kitale, were transferred in July, 1934, to a more convenient site on the Experimental Farm near the coffee plantation. As these plots are barely re-established nothing can be usefully added to the remarks made in my 1933 report.

Arrangements have been made, in connection with a general "mixed farming" co-operative scheme, to plant a much-needed trial on a field scale of certain mixtures for temporary leys and permanent pastures on the farm of A. Wartnaby, Esq., Kitale.

Samples of numbers of European grasses and clovers were kindly presented for trial by "Trifolium", a Copenhagen firm of seedsmen. These were planted in July on new land which, unfortunately, was consequently rather sour. Several of these importations showed promise, notably some varieties of *Trifolium pratense*. However, a drought in September hit the plants hard and it is doubtful how they will recover after the 1934-5 season. These trial plots of grasses and other plants, both local and from all over the world, included about 130 different species or varieties, of which ten were indigenous legumes for green manuring and other purposes. The list is too long to recapitulate here, but it may be stated with confidence that there is not likely to be any difficulty in obtaining authoritative knowledge during the next few years of suitable mixtures for the provision of pastures of high feeding value in the district and probably also for temporary leys for use in a rotation. It is perhaps indicative of the present elementary and extensive type of dairy farming which is practised in the Trans Nzoia that relatively few farmers have shown keen interest in this side of my work up to the present.

Paddocks.

The paddocks planted in 1933 became quite well established in 1934. No accurate records are kept but the four acres must have kept about one cow to three-quarters of an acre from April till the middle of December. Late December rains prolonged the growth of grass and relieved the demand on fodder crops. The "complete fertilizer" strip showed a marked improvement in sward over single fertilizers, and over strips without one of the manurial constituents. The control (no fertilizer) strip remained poor and contains a considerable proportion of "blue couch" (*Digitaria scalarum*). Nitrogen seems to give the biggest response—unfortunately it is the most expensive element to provide—and rock phosphate does not seem to have produced much effect, though perhaps the phosphated strip is somewhat superior to the limed portion adjacent. As is to be expected, sulphate of ammonia encourages Kikuyu Grass (*Pennisetum clandestinum*) at the expense of the *Lespedeza* spp. The latter crop appeared abundantly at the onset of the rains from the seed self-sown from the 1933 growth and provided four or five months' grazing of high protein content which was much relished by the cattle. These paddocks were not intended to give information on highly novel pasture mixtures; nevertheless much practical and valuable information has been gleaned. The planted

paddocks provide much more and better grazing than the two veldt grass paddocks which have not yet developed a close sward after two years' intensive rotational grazing. During the dry season the brighter green of the artificially planted paddocks could be noticed from some distance away and the response to rain is more marked than in the natural grass enclosures. Kikuyu grass evidently has considerable merit as a drought resistant grass and retains its palatability in the dry weather. This grass is indigenous in the district and appears spontaneously where there is abundant humus as in old bomas. It is merely short-circuiting a natural sequence if Kikuyu Grass is planted where intensive grazing methods are to be adopted. Molasses Grass (*Melinis minutiflora*) was grazed greedily and showed exceptional powers of response to light showers of rain. *Paspalum dilatatum* also was kept tightly eaten down and this again is drought resistant to a marked degree; nor must its cousin *Paspalum scrobiculatum* be scorned.

It seems that a certain amount of Teff Grass (*Eragrostis abyssinica*) may well be planted in a grass mixture to afford early grazing while the perennial grasses are establishing themselves.

The native cow mentioned in my 1933 report was dried off in September, 1934, after a first lactation of 427 days during which she produced 2,074 lb. or 207.4 gallons of milk. She is due to calve again in the middle of January 1935 after being dry for four months.

Forage Crops.

Maize silage was again made and proved a valuable standby in the dry weather both for dairy cows, calves, and working oxen. The supply of Elephant Grass (*Pennisetum purpureum*) is being extended for the oxen. It is most marked how oxen on farms in the Trans Nzoia, where there is an abundant supply of Elephant Grass, keep in excellent condition during the dry season, even when working, as compared with those on farms where this fodder has not yet been established. Nandi Cowpeas were planted at the beginning of August in between the rows of maize grown for silage which was cut in September. Cowpea hay was made in November and an abundant second growth appeared which might be used for hay, grazing or green manuring, in 1935.

Sweet potato haulm was fed to cows and calves, all of which relished this fodder.

Complete failure resulted from efforts to induce the cows to eat Edible Canna. The oxen picked off the leaves but evidently found the stems too fibrous to be dealt with other than perfunctorily. This crop will be discontinued.

Twenty-four small trial plots were planted of European fodder crops, including the following :—

Turnips	Thousand-head Kale
Rape	Drumhead Cabbage
Forage Oats	Carrots
Mangolds	Swedes
Marrowstem Kale.	

The turnips suffered badly from beetles and caterpillars. It is probably necessary, for climatic reasons, to plant such crops in July : the turnips are then ready for use in November, they could not be clamped without rotting in the hot dry season and they tend to rot if left in the ground. I do not consider this a useful crop for feeding to cattle in the Trans Nzoia. The swedes did not suffer from insect attack and are about a month later in maturity. The best swede tried was Bangholm Improved Purple-top No. 4056, the best root of which weighed 3 lb. Mangolds deserve more consideration as a succulent crop for dry season feeding of dairy cows, especially since the expense of cultivating the crop is small in Kenya compared with that in England for example. The English varieties were planted on July 11th. The Danish kinds were planted ten days later but the weather conditions apparently were not nearly so favourable and the mangolds did not do nearly so well, though the reason is probably not varietal.

The mangolds were mature in the third week of January at a parching time when such a juicy food was much appreciated by the cattle. The roots were not affected in the least by the heat and drought and could be fed direct into the field, leaves and all. The Yellow Globe mangold was the largest, the finest root—grown on poor, unfertilized new land—weighed 13½ lb. and was 2 ft. 3 in. circumference. This variety, however, showed a certain tendency to split and rot when rains occurred after a considerable droughty period. The variety Perfection was a good quality mangold, smaller in size, which did not split : the best root weighed 6 lb. The Red Intermediate was also of good quality and practically free from splitting and many of the roots were around 10 lb. in weight, the best weighing 12½ lb.

The cabbages grown were quite successful but really need conditions of rather higher fertility. They suffered to some extent, especially the "Champion Drumhead" cabbage, from the ravages of insects, particularly in droughty weather. It would be better to transplant young plants raised first in a nursery. At the end of January the cabbages planted on July 11th began to drop their lower yellow leaves. However, the cabbages provided a popular article of food for some young stock who did not show the enthusiasm for roots which was shown by the older cattle.

A quarter of an acre of the high-yielding *Panicum trichocladium* was planted for purposes of cutting for "green soiling" and is establishing itself very rapidly by rooting at the nodes of the running stems. This plot has not yet come into practical use.

(e) *Canning.*

1934 saw the death, after months of correspondence, of the scheme for a canning industry in the Trans Nzoia. The firm which was interested decided the prospects of an export trade in canned vegetables and fruit were uncertain and that, while a local East African trade was more hopeful, the firm was not prepared to bear anything but a share of the cost of a factory. Since the Trans Nzoia district has been largely drained by the goldfields of capital available for investment this meant the end of the scheme, for the moment at any rate. It is possible that the project would have received more support in the more prosperous times obtaining before the economic depression set in. Meanwhile several local growers are conducting a trade with the goldfields in fresh asparagus and other vegetables.

It is unfortunate that, together with the dropping of the scheme for a canning factory, interest has apparently died in the possibility of an export in pineapples, which would seem to offer a golden opportunity, if properly handled, even allowing for high freight charges. At present there is only one grower in the district who grows the fruit on any scale, Mr. H. Mitford Bowker, of Kitale, who has twenty acres of the fruit and is extending his acreage as far as the available supply of Smooth Cayenne suckers permits. Mr. Bowker sends regular supplies of high quality fruit to Nairobi and Mombasa and contemplates making shipments to Egypt.

(f) *Maize Seed Competitions.*

The Maize Seed Competition trial plots, carried out on behalf of the Royal Agricultural and Horticultural Society of Kenya, was planted in 1934 on the farm of Capt. L. A. Elmer, Kitale. The seed from twenty-eight entrants was planted in twelve blocks, each of which contained a randomized series planted from seed of all the competitors.

The benefit of seed adapted to local conditions was illustrated by the fact that the eleven entries from the Kitale-Hoey's Bridge area were all in the top half of the yield table at Kitale, including the top three competitors.

The plots were on 14-years'-old land and although the maize early on looked like giving 18 bags an acre, ten or twelve inches of rain in August followed by a severe drought in September reduced the crop to an average of 12.22 bags, the first prize winning seed giving a yield of 13.88 bags and the bottom yield being 10.30 bags.

(g) *Maize Breeding.*

My report on the progress of the work of producing a strain of disease resistant maize suitable for the Trans Nzoia appears in the report of the Senior Plant Breeder and Experimentalist.

(h) *Soil Erosion.*

In the conclusion of an article I wrote in 1931, on "Maize in Kenya", published in the March 1932 issue of *Tropical Agriculture*, I stated: "Unless erosion is promptly met by adequate draining, employment of green manures and cover crops, afforestation and use of 'wash stops', it is inevitable that large portions of the settled areas which are now fertile will become barren wastes". Since that sentence was written it has become increasingly evident that only a vigorous campaign in the Trans Nzoia can save large portions of the district (more particularly those with a sandy loam soil) from the disastrous position as regards erosion into which Ceylon and large parts of South Africa have been brought. Palliative measures have become no longer sufficient and the effect of the heavy rains of 1934 after a long dry season demonstrated the urgency of the situation. Fortunately some individual local knowledge was to hand. Some three years ago Messrs. Barnes' Bros., of Hoey's Bridge, far-seeing and scientifically-minded farmers, had laid out about twenty acres of their maize land under the American system of Mangum broad-base terraces. This has been so successful in eliminating wash

that Messrs. Barnes Bros. are gradually terracing their whole farm. Further impetus was given to the force of example of these farmers by a most successful Farmers' Day held on the farm on October 2nd when thirty farmers from the Trans Nzoia and Uasin Gishu districts attended. I gave a lecture on various aspects of soil erosion while the Messrs. Barnes Bros. spoke on the practical side of terracing and demonstrated the setting-out and construction of broad-base terraces. Later I arranged with Mr. Geoffrey More for a badly washed maize field on his property adjoining the Experimental Farm just outside Kitale to be terraced co-operatively with my assistance as a demonstration for those farmers of the Trans Nzoia who live nearer to Kitale than to Hoey's Bridge. With the energetic help of Mr. More the work has proceeded apace and before 1935 is halfway through about 150 acres of typical Trans Nzoia maize land, with characteristically complicated slopes, will have been protected from erosion by broad-base terraces. The slopes varied from 3 per cent to 6.8 per cent on this field but slopes up to 22 per cent have been measured on Mt. Elgon shambas. It is most gratifying that great interest has been shown by farmers in both the Trans Nzoia and Uasin Gishu districts in this method of countering the erosion which will otherwise destroy, in a relatively short space of time, a great part of the cultivated land in this district. Many farmers have already started this work on their own farms and are acting as conscious or unconscious propagandists in many parts of the area. A lively hope may be entertained that during the next few years the greater part of the arable land in the district will have been protected from erosion by terracing. At the same time there is a wider appreciation of the part played by grass fires in depreciating the fertility of the district and during 1935 it is intended to carry on, in conjunction with the Kenya Arbor Society, a campaign against this annually recurring evil and to encourage afforestation throughout the area.

(i) *Experimental Farm, Kitale.*

For reasons of greater convenience and economy it was decided to close down several of the outside experimental plots in the Trans Nzoia at the end of the year and to concentrate to a greater extent on the Experimental Farm site, the conditions of which may be considered reasonably analogous to those on sandy-soil farms in most parts of the Trans Nzoia. During 1934 seven acres of land were prepared for use in

1935 for the Maize Breeding Plots and the Maize Seed Competition. The amount of coffee was brought up to three acres and further extensions of the coffee plantation are necessary and inevitable in the near future.

An area of one acre of Elephant Grass was planted for the dry season feeding of the oxen and from this acre further planting material will be taken in 1935. Two series of eight compost pits, 24 in. by 12 in., were established during the year, utilizing dung and litter from the ox boma, and wood ashes collected in the labour lines. A concrete lined pit was constructed in connection with the composting which holds 6,000 gallons of water and is filled from the main-road ditch, one inch of rain sufficing to fill the pit from which the water is pumped to the compost pits.

At present considerable inconvenience is caused by the office, first rented by the Department of Agriculture in 1931, being two miles from the chief centre of experimental activities; further, much difficulty and annoyance is caused by the absence of any adequate storage accommodation for the valuable seeds of maize, green manure and cover crops, etc., which are developed and multiplied during the course of the work. Only one who has worked under such adverse conditions, involving an almost complete lack of necessary facilities for storing and examining seeds, can appreciate the anxiety and harassment caused by such a state of affairs.

General.

On the whole this was a favourable year for agriculture in the Trans Nzoia. Rains were but little below the average even if they were somewhat patchy. The coffee crop was good, yielding 7 cwt. and upwards on many plantations, though Coffee Berry Disease and Anthracnose have caused much loss and worry in some quarters. Considerable plantings of coffee took place during the year.

The Senior Coffee Officer visited the district in March and I arranged meetings on the plantations of Messrs. Jackson (Mount Elgon), D'Olier (Endebess), Elmer (Kitale), and Howard (Cherangani). Mr. Trench's demonstrations of pruning did much to spur local planters into better and more drastic methods and it may be said that during the year a marked improvement was noticeable in the standard of pruning achieved in the district, though there are still many planters who shrink from carrying out faithfully the principles of multiple stem pruning.

The maize crop was fair, though excessive rain in August followed by dry weather in September reduced the crop materially.

Pyrethrum has gained in favour and does well on Mount Elgon, especially at the higher altitudes, though on the sandy soils at lower altitudes the crop flowers but uncertainly and sporadically.

The co-operative attempt at the introduction of the cultivation of alternative export crops met with a most unfortunate season and is believed to have been a general failure. Such crops as peas and beans are very much at the mercy of the season and it is to be feared that the low yields resulting from the exceptional August and September weather will have effectually discouraged the reluctant experimenters from further efforts to diversify their farming. Maize, coffee and to a lesser extent pyrethrum, seem likely to retain a supremacy from which it will be difficult to dislodge them.

Very little progress can be reported in the direction of mixed farming including dairy herds as an integral part of the farming organization. The imminent erection of a Creamery at Eldoret may accelerate development on these lines in the Trans Nzoia during 1935. Capital is often short where fencing and a dip is needed before starting to "grade up" a herd and the low yielding capacity of the average unimproved native cow is such as to discourage any more advanced methods of feeding and pasture management.

The large acreages of maize common on farms several years ago are now the exception and green manuring is becoming a fairly well-established and approved farming practice. Composting is a means of improving soil fertility which at present is only being dallied with as an idea by most farmers and is likely to be taken up more by the smaller farmers than on the larger estates.

Perhaps a word of warning would be timely as regards the flight from large maize acreages—some farmers have told me that in 1935 they intend only to grow maize on the parts of their fields where the wash has collected—and that is that where yields are only medium it is not to be expected that a *good* living can be made off a very small acreage with maize prices largely dependent on an export price which is likely to remain low. In order to obtain the greatest net income careful estimation must be made of the most suitable

conjunction of acreages and yields commensurate with the available equipment and supervision. This may seem self-evident but apparently it is not so.

It is pleasing to observe that the spirit of optimism in the district noted in my 1933 report has been maintained during 1934 and it is sincerely to be hoped that the gradual but noticeable improvement in the standard of farming in the district will continue to reap its own reward in better crops. Better prices are, except where quality is concerned, a matter under international not local control.

Again I have to tender my thanks to Messrs. Estates and Investment, Ltd., and to Messrs. Elmer, Gilson, Cardale Luck and More, for the many and various ways in which they have assisted me and to express my appreciation of the amicable relationship which has been maintained between myself and the farmers of the district, thereby making my duties more pleasant to perform and my opportunities for rendering assistance more frequent.

COLIN MAHER,
Agricultural Officer.

REPORT OF THE AGRICULTURAL OFFICER, NYANZA PROVINCE, ON INVESTIGATIONAL WORK

Experimental work was carried out at Bukura Farm; Kakamega, Maseno and Kisii Local Native Council seed farms; and in the Malakisi, Samia, Kano and Kendu plots.

(a) In Bukura the work has been confined to small-holding problems, soil control and rotations, and the trial and selection of certain crop plants.

(1) *Sorghums.*

The Agricultural Officer, Bukura, writes :—

“ . . . During 1933-34 a number of introduced varieties and several local native varieties were under observation. Of these, the native variety Ik'umba, a white-grained sorghum, stood out as being very suitable to local conditions and having desirable characters.

Selection to obtain a strain of Ik'umba having a dwarf habit, a close panicle and early maturity, together with good grain characters and freedom from disease, has been carried out during the last two years and is still progressing. The type in course of selection is quite distinct from the more common native Ik'Umba which is tall with a lax panicle.

Of the introduced varieties there was a group from Egypt (Giza varieties), a group from Nigeria, and three varieties from America (Early Red Kafir, Sunrise Kafir and Dwarf Yellow Milo).

There were also one or two other varieties as shown in the 1934 table of results.

The 1933 results for all these introduced varieties were disappointing and even allowing for the fact that they had not been fully acclimatized it was evident that the majority would be of no use.

In 1934 all varieties were planted out in a variety trial with seed obtained from the 1933 isolated bulking plots and with original introduced seed, in cases where bulking had failed in 1933.

The newly discovered native variety “Kano” was also included in this trial.

The results were as follows :—

VARIETY	Maturity	Per cent	Germination Habit	Yield per Acre
	<i>Days</i>			<i>Lb.</i>
Dwarf Yellow Milo..	145	80	Dwarf	513
Sunrise Kafir ..	155	75	Tall	432
Early Red Milo ..	170	75	Dwarf	702
Kano	149	95	Dwarf	702
Ik'umba	155	100	Dwarf	270
Black Hull Kafir ..	160	75	Tall	486
Pink Kafir	163	80	Dwarf	540
Okunjo	160	75	Tall	972
Eshiro	163	90	Tall	324
Tall Ik'umba ..	Discarded, not true to type.			
Giza 4	Complete failure. Failed to develop seed. Seed used twice grown at Bukura. Very susceptible to disease.			
Giza 10				
Giza 16				
Giza 20				
Giza 25				
Red Seeded Yandev	Failure.			
White Seeded Yandev				
Mixed Yandev ..				
Busa				
Oka Funfun.. ..				
Kaura				
Farafara				

Planted : 8/3/34.

Varieties : 22.

Area of plots : 1/17th acre.

Remarks.—Dwarf Yellow Milo was notable for its comparatively early maturity, but had no other characters to recommend it.

Early Red Kafir gave the best yield of the introduced varieties, but was late in maturing and very susceptible to disease, despite its good yield. Okunjo gave the best yield of all, but its tall growth and lax panicle do not recommend it.

Kano was easily the best ali round variety. Ik'umba did not do well in this trial. On other occasions Ik'umba has given a good yield and in other ways has done well.

In the separate 1934 bulking plots Kano and Ik'umba gave the following yields :—

Ik'umba : 802 lb.—4 bags per acre.

Kano : 1,044 lb.—5 bags per acre.

(The plots were on similar soil, but these results of course, are not comparable statistically.)

In ratoons on the bulking plots Ik'umba did considerably better than Kano.

The net result of the trials of sorghums over the last few years has been to show that so far no introduced variety is so good as Kano and Ik'umba. These varieties have dwarfness, closeness of panicle, early maturity, sturdiness of growth, good yield and good grain characters, and appear to be eminently suited to the conditions of the sorghum growing areas in Kavirondo.

For the present, work on sorghums will be confined to the development of these two types and of the selected type now named 'Dobbs'."

(2) *Tobacco.*

The Agricultural Officer, Bukura, writes :—

"Only one variety of tobacco has been under trial at Bukura, namely 'Western Dark Nyasa'.

(The Kavirondo native type was tried out at Bukura during 1934, but failed.)

In 1932 an observation plot was planted out. Growth was found to be very good; therefore in 1933 plots were planted for seed and leaf. The crop was introduced in the small-holding-without-pasture rotation.

In 1934 seed was issued to South Marama location of North Kavirondo and seed bulking was continued at Bukura.

Plots from leaf curing were also planted. From an unmanured plot on poorish acid loam, lacking in phosphates, a yield of 192 lb. per acre of fire-cured leaf was recorded. Under native conditions of cultivation, with strip inter-planting of legumes, as is now being recommended, a yield of at least 200 lb. per acre of fire-cured leaf can be regarded as certain. The soil in the Butere tobacco growing area is in almost all cases better than the soil of the Bukura trial plots. As skill in curing improves among the native producers, yields will increase because the soil is potentially good tobacco growing soil.

Although no specific trial was planned in 1934 to test optimum sowing and transplanting dates, many sowings and transplantings, in both long and short rains, during the years 1932-33-34 have been observed and the following suitable sowing and transplanting dates for this area have been recorded :—

Sowing in nursery : May.

Transplanting to field : July.

Harvest : October-November.

The only other practicable dates are February-March-July. Both seasons are to be tried in 1935.

Production of seed.—A large quantity of seed from selected plants has been produced in 1934. Assuming that only good plants, showing the desired leaf characters, are kept for seed production, and that all diseased plants are discarded and burnt, the most satisfactory seed is produced by nipping off secondary flower shoots and harvesting the fruits when still yellow and before they have turned brown or started to dry up in the field. The pods are then dried off in a barn.

Remarks—

Average germination : 8 to 9 days.

Average time to transplanting : 8 to 10 weeks.

Average maturity from transplanting to harvest : 12 to 15 weeks.

Second pickings.—Leaf growth from secondary suckers are not satisfactory on Bukura soil but would be worth encouraging on the more fertile soils in the present tobacco producing area.

(3) *Leguminous Green Manure and Cover Crops.*

The Agricultural Officer, Bukura, writes :—

“The following species have been tried during the last three years, with the object of discovering those most suitable for use on the Bukura station :—

1. *Calopogonium orthocarpum*.
2. *Centrosema plumieri*.
3. *Centrosema pubescens*.
4. *Dolichos hosei*.
5. *Dolichos lablab* (Njahi).
6. *Phaseolus aconitifolius*.
7. *Phaseolus calcaratus*.
8. *Pueraria phaseoloides*.
9. *Stizolobium aterrimum*.
10. *Stizolobium deeringianum*.
11. *Pueraria thunbergiana* (Kudzu vine).
12. *Mucuna* sp. (Black Mauritius Bean).
13. *Canavalia ensiformis*.
14. *Pisum sativum* (Field pea).
15. *Phaseolus vulgaris* (Canadian Wonder Beans).
16. *Crotalaria axilaris*.
17. *Crotalaria kirkii*.
18. *Crotalaria alata*.
19. *Crotalaria invariantulensis*.
20. *Crotalaria juncea* (dwarf form).
21. *Arachis hypogaea* (groundnut).
22. *Mucuna* spp., etc. (six kinds of local indigenous legumes).
23. *Tephrosia toxicaria*.
24. *Lupinus* sp. (Palestine lupin).

All have been grown in observation plots for at least two seasons, and final decisions have been made during 1934. Nos. 1, 7 and 8 gave an excellent bulk of green matter suitable for ploughing in, but were discarded on account of the difficulty of propagating them. They neither set seed freely, nor could they be propagated satisfactorily from runners.

Nos. 3 and 4 gave an excellent low mat cover, suitable for soil cover in an orchard, but these, again, had to be discarded owing to the great difficulty, under normal conditions, of propagating them.

Nos. 2, 6, 11 and 18 were discarded because they were altogether failures.

Nos. 9, 13, 15, 19 and 23 have been discarded because their growth and general characters were not good, despite the fact that they set seed well and would be easy to multiply.

Nos. 10 and 20 and 24 are recent additions to these trials and definite results have not been arrived at yet. Seed is being bulked.

No. 22 represents six indigenous legumes collected and tried in 1933. Of these one, numbered N. L/1, a *Mucuna* sp., has been selected, and has been tested for growth and ease of ploughing in, during 1934. Seed has been bulked.

The others, Nos. 5 (Njahi), 12 (Black Mauritius Bean), 14 (Field peas), 16 (*Crotalaria axilaris*), 17 (*Crotalaria kirkii*), 21 (Groundnut), and 22 (N.L/1) have proved the most satisfactory and are now in use at Bukura under field conditions, as green manures and covers. Field experiments with these are now in progress. From these plants one or more could be recommended for use in the reserve, if required, on, for instance, a native small-holding.

All of these species now in use regularly develop bacterial root nodules, either naturally, or as the result of soil inoculation (*see* separate paragraph).

Of these seven varieties, Black Mauritius bean and N.L./1 are long term green manures. Black Mauritius bean has been included in the Bukura maize rotation (outer fields) as a green manure interplanted between maize. Maize spacings tried have been :—

(a) 6 ft. x 1 ft.

(b) 4 ft. x 2 ft.

Spacing 6 ft. x 1 ft. gave poorer yields and was very liable to beating down by wind and rain. 4 ft. x 2 in. was not found to be too close for the proper growth of the interplanted crop.

Planting times of the green manure crop that have been tried have been :—

(a) After the first cultivation of maize spaced 6 ft. x 1 ft. (giving alternate rows of maize and beans 3 ft. apart).

(b) After the last cultivation of maize spaced both 6 ft. by 1 ft. and 4 ft. x 2 ft.

Method (b) is the better. If the beans are planted earlier as in method (a), they tend to climb up the maize stalks at about the time when the maize is drying off.

Combining these results, the best method for interplanting Black Mauritius beans between maize, as a long term green manure, was found to be between maize spaced at 4 ft. x 2 ft. and time of planting after the last intercultivation of the maize.

N.L/1 promises to be an alternative to Black Mauritius bean and has the added advantage that seed can, in the first instance, be obtained locally (useful for green manure to be used on a native small holding). Apart from the tests of this variety mentioned above, however, no further trial has been possible. Sufficient seed has now been bulked to enable more extensive tests to be made in 1935.

Njahi (*Dolichos lablab*) and Field Pea are used as green manures in the smallholding rotations, both with and without pasture, being planted in the short rains after a long rains crop and ploughed in before the next long rains crop. Njahi is the better as peas tend to die off too soon and leave the soil uncovered.

Crotalaria kirkii and *Crotalaria axilaris*, although provisionally selected from the original twenty-four species tried, are still in the experimental stage. When grown well and in a good season, the cover, mulch and green bulk provided by these two species, especially *C. kirkii*, is undoubtedly better than that produced by any other leguminous plant tried at Bukura, with the exception of the two long term green manures noted above. They are rather uncertain, however, as their germination is unreliable (the seed is small) and they can be very slow in getting a hold of the soil and shooting up.

In July 1934 two plots, one of *C. kirkii* and one of *C. axilaris* were interplanted in maize just before the harvest. A plot of ploughed weed-fallow following the maize, and a plot of ploughed, bare fallow, also following the maize, are adjacent. All four plots will be ploughed together and planted with maize in the long rains 1935 and observation of the maize in the four plots will be recorded (Field 5).

Groundnuts have now been planted in the short rains following *wimbi* for two years and are a thoroughly reliable soil renovator here. They are too slow, however, to follow maize.

NODULATION OF LEGUMES

BACTERIAL GROUP	Nodule Formation	Possible Indigenous Leguminous Plant
Black Mauritius Bean	Good after artificial inoculation, but now appears to nodulate naturally as well.	<i>Mucuna</i> spp.
Groundnuts ..	Fairly good without artificial inoculation.	<i>Phaseolus</i> and <i>Vigna</i> species occur in the neighbourhood.
Field Lupins .	Good after initial artificial inoculation, occurs naturally as well.	Not known.
Pigeon Peas..	Varies according to variety, but present without artificial inoculation.	General of Group I.
<i>Crotalaria</i> spp.	Occurs, but not very good. Originally inoculated, but now not dependent on that.	Ditto.
Njahi ..	Abundant, after initial artificial inoculation.	Ditto.
Canadian Wonder and Pinto Beans.	Fairly good without artificial inoculation.	Not known.
Field Peas ..	Slight, without artificial inoculation.	<i>Lathyrus</i> and <i>Vicia</i> spp.
Sword Bean..	Slight, after artificial inoculation.	General of Group I.
Soya Beans ..	Very few. No artificial inoculation.	Ditto.

(4) *Pigeon Pea Variety Trial* : Bukura, 4,800 ft.

Ten imported varieties tried with New Era as control.

Growth was extremely poor with these ten dwarf types. Seed from the small harvests was sown out again in July and results may be gained from the acclimatize seed.

Pigeon Pea Variety Trial : Kano Plains, 3,700 ft.

From India, once grown in Tanganyika.

VARIETY	Yield per Acre	Remarks
	<i>Lb.</i>	
Pusa 15 ..	1,005	} First flowering failed and plants were pruned and harvested at 259 days from date of sowing. Growth was sparse and height from 3'6" to 4'.
Pusa 16 ..	955	
Pusa 51 ..	938	
Pusa 24 ..	687	
Pusa 50 ..	402	
New Era ..	—	Too late to be a useful control.
Pusa 64	}	Growth was poor and yield low. All destroyed.
Pusa 82		
Pusa 82		

The Pusa 15, 16 and 51 showed the best yield as well as appearance and will be put under further trial in 1935. Pusa 24 and 50 will also be destroyed.

(5) *Groundnuts : Bukura.*

The Agricultural Officer reports ten varieties, six of which are new importations, but as these are not yet acclimatized, nor are the Bukura conditions favourable to this crop except as a green manure, the results will not be reported.

Spacing trials with groundnuts were laid down at Bukura, as well as interplanting trials with cotton and groundnuts. These will be reported on next year.

(6) *Groundnut Variety Trials : Kano Plains, 3,700 ft.*

Conditions favourable, soil a very sandy loam, rainfall very short, growth luxurious, no Rosette disease evident, planting replicated three times, sown in rows 3 ft. apart, one row of soya beans between each variety to ensure segregation.

VARIETY	Period	Yield per Acre	Type
	<i>Days</i>	<i>Lb.</i>	
Native Local	168	1,943	Creeping.
Shirate	168	1,900	"
Jumbo	168	1,641	"
Konno	168	1,597	"
Zanzibar (var.)	168	1,551	"
India	168	1,446	Low creeping.
Butere	168	1,425	Creeping.
Akola " 10 " (P.T. F741) ..	161	1,382	Bunch.
Homa	168	1,209	Creeping.
Tanganyika (var.)	168	1,209	"
Akola " 12-24 " (P.T.F.) ..	168	1,015	Bunch.
Virginia Bunch	161	936	"
Asembo Red	156	928	"

Groundnut Spacing Trials : Kano Plains, 3,700 ft.

The seed was the creeping variety from Kendu. Growth was stunted to start with due to drought, but recuperated to a very luxurious growth. Leafage at all spacings formed a complete cover. Period from date of planting till date of

harvesting was 165 days. The weights given are of shelled nuts. Plots were each 1/160 acre and replicated twice. No Rosette disease.

Spacing Distances	Yields per Acre
	<i>Lb.</i>
3 ft. by 1 ft. ..	1,808
2 ft. by 2. ft. ..	1,688
2 ft. by 1 ft. ..	1,390
18 ins. by 9 ins. ..	2,100
18 ins. by 6 ins. ..	2,110

Groundnuts with manure : Kano Plains.

This trial was only done on a small scale with two 1/160 acre plots as a demonstration to the local natives. They were very impressed with the result attained but it is doubtful whether they will yet follow the example. "Asembo" bunch was used.

Manure	...	...	...	2,240 lb.
No manure	...	...	...	1,290 lb.

*Groundnuts interplanted with Maize and Cowpeas :
Kano Plains.*

There was no Rosette disease evident.

Plots 1/160 acre each.

Replicated twice.

Maize is recommended to the natives when spacing is irregular and about 4 ft. apart to keep crows from flying into the under crop.

The Cowpeas crop does not appear to attain any advantage and is not recommended.

METHOD	Yield per Acre
	<i>Lb.</i>
Groundnuts with Maize	1,270
Groundnuts with Cowpeas	1,040
Groundnuts	1,950

(7) Sweet Potatoes : Bukura, 4,800 ft.

Three varieties again tried. Yields have already been reported, but though Early Butter and Calabash Leaf are good yielders the Uganda variety is recommended on account of its

satisfactory yield, good flavour and ease of propagation. Vines of the former usually die off before the next planting season.

-(8) *Lemon Grass* (*Cymbopogon martini* vars.).

Sofia and *Motia* have been discarded, *sofia* because it gives an inferior oil and *motia* because it is a poor leaf producer.

Cymbopogon Citratus is being bulked by using it as a wash-stop till prices improve for the essential oil.

English Potatoes : Kakamega, 4,800 ft.

VARIETY				Period	Yield per Acre		
				Days	Tons	Cwts.	Lbs.
Great Scott	..	..	..	102	7	6	16
Kerr's Pink	..	..	..	88	6	7	32
Abundance	..	..	..	102	5	8	48
Doon Star	..	..	..	102	5	1	40
The Baron	..	..	..	88	3	18	0

In Bukura all other varieties have been eliminated, and Great Scott kept for future planting. Kerr's Pink is suitable in Kisii.

(10) *Beans* : Bukura.

Pinto beans and White Sugar beans were bulked in the short rains. Both are promising varieties for the farm.

Bean Variety Trial : Kano.

The varieties were Rose Coco, Canadian Wonder, Tepary and Ootootan Soya, replicated three times.

Drought was severe and the former two died off. Soya gave a small yield and Tepary 470 lb. per acre.

Soya Bean Variety Trial : Kano Plains, 3,700 ft.

Row trials were made and a certain amount of suppression existed causing unfairness to the lower growing varieties. The stand and weight of green matter were greatest in Ootootan but no yields can be given from these single row observation trials. Natives appreciate the crop for food and may be induced to take it up seriously.

VARIETY				Period	Height	
				Days	Ft.	Ins.
Ootootan	..	..	..	97	2	6
Suttons	..	..	..	93	1	9
Dixie	..	..	..	97	1	6
Ludwig	..	..	..	97	1	6

(11) *Coffea stenophylla* : Bukura, 4,800 ft.

This has been in the land for two years now, and made no growth yet.

(12) *Wheat Variety Trials* : Kimilili, 5,800 ft.

Three new types of wheat and Sabanero were obtained from the Plant Breeding Station for trial at Kimilili and Kisii, both at altitudes of 5,800 ft. A variety of wheat of unknown origin, but grown locally in Kisii district for many years, was also included in the trials. The earlier maturing wheats, taking only four to four-and-a-half months to mature, did best; those were Nos. 256, 59, Sabanero and Kisii variety No. 112, taking five months to mature was not quite so successful. Yields were of the order of five bags per acre off plots 200 square yards in area.

(13) *Rice Variety Trials* : Kano, 3,700 ft.

NAME	Period	Yield of Paddy per Acre	Remarks
	<i>Days</i>	<i>Lb.</i>	
Mwanza Sena	116	6,277	Still stands best.
Mwanza Maji Maji ..	116	5,590	Still stands second best.
Faya	123	4,990	
Ambare Kore	113	4,680	Tana River var.
Fodea (PTF 600) ..	161	4,530	Too late.
D.C. (PTF 598) ..	113	4,310	
Bai Salay (PTF 604) ..	161	4,005	
Halkaduwi	123	3,855	
D.C. pal-lil (PTF. 599) ..	161	3,630	Too late.
Caloro (PTF. 606) ..	82	3,025	Useful early.
Bungala	116	2,870	
Ambare Nyeupe ..	116	2,722	Kenya Coast.
Kisuki	116	2,720	Tana var.
Kindeadea	123	2,570	Kenya Coast var.
Boering	158	2,570	
Mumias	116	2,270	Our best upland.
Maziwa	116	2,260	Tana var.
Ambare Nyekundu ..	116	2,260	Kenya Coast var.
Kipole	116	1,885	Kenya Coast var.
Colusa (PTF. 605) ..	82	1,815	U.S.A. var.
Mele Sindano au Sena ..	123	1,735	Kenya Coast var.
Shoemed (PTF. 607) ..	116	750	

(14) *Vernalization of Cotton.*

Seed was N.17, which is the type grown in this region.

Two treatments used, viz. :—

- (1) Seed kept slightly moist and temp. 25° C.
- (2) Seed kept moist throughout and temp. 32° C.

Period nine days with no light allowed to reach the seed except when temperatures were being taken.

Planting : Row plots, replicated twice with untreated seed as a control.

Germination : No apparent difference.

Growth : No apparent difference.

Crop : No apparent difference.

MINOR EXPERIMENTS.

(1) *Peas : Yellow Victoria Pea* (PTF. 815).

Very fine samples obtained and planted in Kakamega and Maseno farms. First harvest yielded less than the seed planted, but growth appeared to be good throughout. Kakamega planted the seed a second time and got better results. There were no bacterial nodules seen on the roots.

(2) *Beans : Kakamega.*

The following dwarf varieties were supplied by the Senior Mycologist to test for blight resistant qualities :—

Abundant.

Ne Plus Ultra.

Black Wonder.

Superlative.

They remained free from the disease throughout the trial.

(3) *Tobacco : Bukura.*

Natives are unable to carry out all three curing processes in one barn and a method was tried to do the wilting in one barn, while the preliminary drying, keeping quality and attaining the aroma and then final drying out, was done in the second barn. The results attained are satisfactory.

(4) *Onion Varieties : Kano Plains.*

Three varieties were sown. Yellow Improved Cape failed to germinate. The seedlings were planted out on very firm and slightly raised beds. No manure applied.

VARIETY	Period	Yield per Acre	Keeping Quality
	<i>Days</i>	<i>Lb.</i>	
Moshi	120	15,119	Still sound at 4 months.
Yellow Bermuda ..	105	27,973	Poor keeper and colour not attractive.

(6) *Cotton Variety Trial for observation.*

The following varieties were planted in row plots. There was a great deal of branch interlacing. Subsoil drainage was bad and bolls became diseased with all varieties.

Sio local N.17, S.G.29, S.G.27/15/13, SPI., C.15, U.4, U/4/64, U/4/26/4, U/4/4/2.

(7) *Cotton with catch crop.*

Cotton planted 3 ft. x $1\frac{1}{2}$ in. Tepary beans planted with cotton, between the rows.

A good catch crop of beans harvested and cotton did not appear to suffer much.

Tepary was harvested on 77th day and yielded 520 lb. per acre.

(8) *Cotton variety trial at Samia Plot.*

The following ten Barberton varieties were planted in isolated plots with N.17 as control. Observational reports have been made by the Agricultural Officer, Kakamega.

955, 998, U/4/4, 921, 9243, 9355, 920, 9264, 9292 and U/4.

(9) *Cow Pea Variety Trials : Kano.*

Twenty varieties tried and replicated three times. Droughted and all a complete failure.

(10) *Sorghum Variety Trials : Kano.*

Twenty-seven varieties planted in replicated row plots. Of these, eight were first imported from Nigeria (PTF. 684 to 691). They suffered very severely from drought and smut, and only a few returned a little seed. Ocular observations were noted for future guidance.

(11) Amongst other crops and trials put down at the farms and plots were :—

- (1) Cotton cultivation.
- (2) Several varieties of bananas and fruit trees.
- (3) Sugar cane varieties POJ. 2717 and 2878, with Tanganyika and Kampala varieties.
- (4) Hairy Peruvian Lucerne in Kano Plain.
- (5) Italian Millet at 3,700 ft. with successful results.
- (6) Bulbrush Millet at 3,700 ft. with successful results.

- (7) Finger Millet at 3,700 ft. with successful results.
- (8) Pinto Beans.
- (9) Horse Gram. Five varieties: PTF. 619, 624, 625, 630 and 636. Very dense low growth but did not set seed; no market for seed.
- (10) Soya "Otootan" on 1/16 acre yielded 1,512 lb. per acre during the short rains in Kano Plains.
- (11) "Dobbs" Mtama gave the phenomenal yield during the short rains in the Kano Plot of 2,646 lb. per acre on 1/27 acre plot.
- (12) Painted Lady yielded 1,714 lb. per acre in Kano.
- (13) Pyrethrum failed in Maseno and Kakamega.
- (14) Pecan nut—Not making good growth yet in Maseno.
- (15) Kapok varieties in Maseno making no growth, elevation 4,800 ft.

Kano Plains Plot.

This was started at the end of April more as a demonstration for the local natives. They have always maintained that because of flooding, droughts and poor land, nothing will grow with them. They have already been convinced that their belief is unfounded.

Most of the crops planted have given heavier yields and make faster growth than is possible anywhere else in the Province. It is admitted that flooding causes uncertainty but before the end of the year the District Commissioner had commenced work on river clearing, which should do a great deal to regain their confidence.

W. LYNE WATT,

Agricultural Officer.

REPORT OF THE AGRICULTURAL OFFICER, CENTRAL PROVINCE, ON INVESTIGATIONAL WORK

(a) *Plant Trials*.—One hundred and thirty-two plant trials were carried out during the year. The results of the more important are shown in schedule form below. Many complete failures are reported due to drought.

PLANT TRIALS

CROP	FORT HALL		S. NYERI		MACHAKOS		KITUI		EMBU	
	Period	Yields per Acre	Period	Yields per Acre	Period	Yields per Acre	Period	Yields per Acre	Period	Yields per Acre
	Days	Lb.	Days	Lb.	Days	Lb.	Days	Lb.	Days	Lb.
Maize Durum ..	—	—	—	—	—	—	—	6,400	—	1,750
Morogoro Cowpeas ..	—	—	—	—	—	—	—	428	—	—
Green Gram ..	—	—	—	—	—	—	—	230	—	—
Black Gram ..	—	—	93	128	—	—	—	800	—	—
Tepary Beans ..	—	—	71	96	—	—	—	450	—	—
Groundnuts ..	—	—	—	—	—	—	—	1,400*	—	—
Nat. Bulrush Millet ..	130	70	—	—	—	—	—	—	—	—
Bulrush Millet, Tanganyika ..	130	730	161	1,432	90	1,376	—	—	—	—
Bulrush Millet, Indian ..	—	—	—	—	85	1,232	—	—	—	—
Sorghum Borganhilo (White) ..	—	—	—	—	111	1,648	—	—	—	—
Sorghum Borganhilo (Red) ..	—	—	—	—	108	1,812	—	—	—	—
Sorghum M.K.S. ..	—	—	—	—	108	1,008	—	—	—	—
Sorghum Sunrise ..	—	112†	—	—	108	1,520	—	—	136	750
Sorghum D. Yellow Milo ..	—	65†	—	—	108	902	—	—	—	—
Sorghum E. Red Kaffir ..	—	120†	—	—	126	608	—	—	—	—
Guinea Corn Red ..	—	—	—	—	116	1,088	—	—	—	—
Guinea Corn, White ..	—	—	—	—	116	554	—	—	—	—
Guinea Corn Basa ..	—	—	—	—	111	489	—	—	—	—
Guinea Yellow ..	—	—	—	—	125	672	—	—	—	—
Rye ..	—	—	151	955	—	—	—	—	—	—
Peas, Field ..	—	—	109	704	—	—	—	—	—	—

*Unshelled.

†All diseased in long rains.

PLANT TRIALS—Contd.

CROP	FORT HALL		S. NYERI		MACHAKOS		KITUI		EMBU	
	Period	Yields per Acre	Period	Yields per Acre	Period	Yields per Acre	Period	Yields per Acre	Period	Yields per Acre
	Days	Lb.	Days	Lb.	Days	Lb.	Days	Lb.	Days	Lb.
Peas, B.E.S.	—	—	115	659	—	—	—	—	—	—
Peas, Alderman	—	—	116	500	—	—	—	—	—	—
Peas, Jap. Marr. . . .	—	—	138	680	—	—	—	—	—	—
Peas, Harr's Glory . . .	—	—	138	649	—	—	—	—	—	—
Niger Oil	—	—	124	780	—	—	—	—	—	—
Sunflower	—	1,280	—	—	—	—	—	—	—	—
Horse Beans, Cuddapan .	—	—	211	104	—	—	—	—	—	—
Horse Beans, Chittoor . .	—	—	211	136 ¹	—	—	—	—	—	—
Horse Beans, Coimbatore .	—	—	211	84 ¹	—	—	—	—	—	—
Horse Beans, Maduka . .	—	—	211	68	—	—	—	—	—	—
Horse Beans, Kistna . . .	—	—	211	83	—	—	—	—	—	—
Rice, Kisuki	259	1,200	—	—	—	—	—	—	—	—
Rice, Fine	250	2,500	—	—	—	—	—	—	—	—
Rice, Coloro	216	2,600	—	—	—	—	—	—	—	—
Rice, Calusa	221	1,200	—	—	—	—	—	—	—	—
Rice, Shoemed	232	850	—	—	—	—	—	—	—	—
D.C. Rice, Sierra Leone .	232	2,050	—	—	—	—	—	—	—	—
D.C. Rice, Par Lil	289	4,459	—	—	—	—	—	—	—	—
Rice, Fodea	280	850	—	—	—	—	—	—	—	—
Beans, Rose Coco	—	1,100	—	693	—	—	—	—	—	—
Beans, Noyeau Blanc . . .	—	900	—	644	—	—	—	—	—	—
Beans, Painted Lady . . .	—	360	—	—	—	—	—	—	—	—

(b) The variety of climatic conditions obtaining in the Province necessitates continued selection of seed. Maize is regarded as the most important crop at 4,000 ft. and over, and a great deal of work has been done in selecting a type suitable to the Province. Muratha, an early maturing variety, evolved at the Scott Agricultural Laboratories, has been bulked on all seed farms situated at elevations over 4,000 feet.

(c) *Maize Varieties*.—An experiment (statistical) to test the comparative suitability and difference in yielding ability between Guam, Menade, Durum and Muratha. Maize was laid down in October at Kitui and lower Embu. The experiment took the form of randomized blocks.

(d) *Soil Fertility Experiments*.—Two randomized block fertilizer experiments were laid down on the unfertile light land situated on the higher slopes of the Aberdares and Mt. Kenya. The object of the experiment was to discover the cause of the rapid loss of soil fertility after one or two years cultivation. No significant results have been obtained.

(1) *Deep Ploughing*.

Very marked results were obtained by deep ploughing on poor land situated on the slopes of Mt. Kenya. Fertility was greatly increased and an experiment will be laid down next year to determine the exact effects on crop production of varying depths of cultivation.

(2) *Manurial Observational Strips*.

Again, on these light lands, preliminary observational strips were laid down to compare the effect of dressings of boma manure, wood ashes and lime on potatoes. The dressings were at the rate of five tons, five tons and three tons respectively. Yields were as follows:—

Strip treated with—	per annum
Boma manure	4,500 lb.
Ashes	3,750 lb.
Lime	2,100 lb.
Untreated	1,500 lb.

(e) *Fungicides*.—An experiment to test the efficiency of Granosan as a fungicide, against smut in sorghums, was carried out at Machakos with the following results :—

Percentage Smutted Heads per Row—

(a) Untreated controls	...	...	...	55.6
(b) Granosan treated seed	...	...	...	1.2

Weights of Clean Grain Harvested per Acre—

(a) Untreated controls	...	...	1,624 lb.
(b) Granosan treated seed	...	...	2,786 lb.

(f) *Cotton Trials*.—Cotton trials were carried out during the year at Kitui, lower Machakos, Fort Hall, Embu and Meru Districts. Although the year has been an unfortunate one from the point of view of rainfall, much useful information has been obtained on the behaviour of cotton and on the incidence of insect attack. The following points considered worthy of mention are based on results of the trials :—

(1) A poor crop can only be obtained if plants are uprooted after one season's growth.

(2) The incidence of rainfall for the short and long rainy seasons, varies in the cotton belt in different parts of the Province. The planting season in Kitui and probably Machakos Districts in October, while in Embu and Meru Districts April planting is considered best.

(3) The prevalence of insect pests, and especially stainers, is more pronounced in August-September harvesting, than in January-February harvesting.

(4) Ratooning immediately before the rains, has set back the plants too far to enable them to produce a crop before the 'close season' sets in.

(5) A 'close season' of two months can be obtained; namely, September and October in Kitui and March and April in Embu and Meru Districts.

Further trials will be carried out in 1935 to discover the best planting dates and the best times for ratooning.

With the exception of the trials planted in Kitui in November, 1933, complete results are not yet available.

The following are particulars of the varieties, dates of planting and yields in Kitui :—

LOCATION	Variety	Date of Planting	Date of Harvest	Seed Cotton Yields per Acre
				<i>Lb.</i>
Ikanga	U/4/4/2	8-11-33	4-3-34	250
	Uganda	8-11-33	4-3-34	60
	U/4/4/2	19-11-33	16-3-34	90
	Uganda	19-11-33	16-3-34	30
Ikutha	U/4/4/2	8-11-33	4-3-34	300
	Uganda	8-11-33	4-3-34	280
	U/4/4/2	20-11-33	14-3-34	460
	Uganda	20-11-33	14-3-34	100
Kanzike	U/4/4/2	16-11-33	20-3-34	100
	Uganda	16-11-33	20-3-34	100
	U/4/4/2	29-11-33	22-3-34	180
	Uganda	29-11-33	22-3-34	120
Tiva	U/4/4/2	8-11-33	4-3-34	300
	Uganda	8-11-33	4-3-34	340
	U/4/4/2	10-11-33	14-3-34	390
	Uganda	10-11-33	14-3-34	270

U/4/4/2 in each case gave a larger percentage of clean cotton.

The mean total yield from the Tiva carry-over cotton and the ratio of clean to dirty cotton was :—

U/4/4/2—938 lb. seed cotton—ratio of clean to dirty :
1.85 : 1.

Uganda—1,200 lb. seed cotton—ratio of clean to dirty :
1.2 : 1.

The mean total yield including initial pickings before the March rains :—

U/4/4/2—1,255 lb. seed cotton per acre.

Nyanza—1,473 lb. seed cotton per acre.

SCOTT AGRICULTURAL LABORATORIES.

Two experiments connected with systems of native agriculture are reported on by Mr. Gillett, the Agricultural Officer in charge, as follows :—

Mixed versus Separate Planting of Crops.

An experiment laid down to test out the two different methods of planting, although not continued to finality, proceeded for sufficient time to make definite observations and conclusions. It was shown that:—

(a) The yield obtained over the two systems slightly favoured the separate planting. Peas and Beans gave a large increased yield in the 'separate' method of planting. These crops suffer from the dense shade of the maize on the 'mixed' method and hence the yield is decreased.

The tendency for increased yields on the 'separate' method is most probably due to the even spacing of crops.

(b) The simultaneous rotation obtained on the 'mixed' method has great advantages, for example, prevention of soil erosion, etc.

(c) The planting of crops in lines as in the 'separate' method is sound and this should be extended with proper spacing, to the 'mixed' method.

Experimentation on modified lines is being undertaken to evolve the most suitable methods of 'mixed' planting, with the best spacing.

Smallholding Practice. Cropping.—When manure is available, as under this system, it is believed that separate planting is advantageous, provided methods are adopted to prevent soil erosion.

Rotation.—Certain difficulties arise in the formation of a suitable rotation for these areas where maize is the staple food but can only be grown during one season (Long Rains) of the year.

A rotation is being tested out on the 'holding' at this Station and would so far appear applicable to these conditions.

The rotation is as follows:—

<i>Long Rains</i>		Potatoes (manured).
<i>Short Rains</i>	...	Beans or peas.
<i>Long Rains</i>	...	Maize.
<i>Short Rains</i>	...	Potatoes (manured).
<i>Long Rains</i>	...	Maize.
<i>Short Rains</i>		Beans.
<i>Long Rains</i>		Beans and peas.
<i>Short Rains</i>	...	Millet or wheat.

This is an eight-course rotation over four years, which allows the planting of half the whole holding with maize during the long rains. One quarter is planted with a millet or wheat crop during the short rains in case the cereal foods become low before the harvest of the next maize crop. The potato crop is always manured with the cattle dung obtained from the holding. The systematic application of this manure is an essential part of the rotation.

Grazing.

From the first observations made on the rotational grazing paddocks, it would appear that the stock carrying capacity of the land will be very much increased by the replacement of the natural indigenous grasses with Rhodes grass. The one established paddock of this grass is already showing very high qualities. When the cows are grazing in this paddock a rise in both quality and quantity of milk has been observed.

W. G. LECKIE,
Agricultural Officer.

REPORT OF THE AGRICULTURAL OFFICER, COAST PROVINCE, ON INVESTIGATIONAL WORK

The work at Kibarani Station has been continued on the lines of previous years, but extension of the work, long desired, awaited the taking over of the extra land from the owner, which has now been done. Certain crops can now be accepted as desirable introductions to the Coast. Especially is millet, tepary beans, New Era pigeon pea, whilst amongst sorghums a process of elimination has been carried out, leaving two good types, Bonganhilo and Dwarf Hegari (early maturing), against which any further varieties can be tried out. This is an important stage, as it is now possible to bulk these types for seed issue purposes and to proceed to the next step of accustoming the natives to the new types of food, a process which will require time and patience.

Cotton.

Cotton work has consisted mainly of a time of planting trial and a variety trial. The time of planting trial has been carried out annually since 1931 and results have consistently favoured early planting. The figures for 1934 are appended.

YIELD OF 1/20 ACRE PLOTS IN LB.

DATE OF PLANTING	GRADE		TOTAL SEED COTTON	
	No. 1	No. 2	Per Plot	Per Acre
27-4-34	32	2	34	680
11-5-34	26	8	34	680
25-5-34	22	3	25	560
8-6-34	17	7	24	480
22-6-34	21	5	26	520
5-7-34	11	2	13	260

It is clear from these and previous results that it is desirable for planting to be completed before the end of May. Owing to the variability of the onset of the rains, it is not possible to be much more definite but the result can be summarized as follows. The best yields will be obtained by planting as soon as the land has been thoroughly soaked and by completion before the beginning of June.

The result accords with the ideas that were underlying the initiation of the trials and confirms the field policy then adopted of early planting. A continuation of the experiment therefore, is no longer necessary.

In the variety trials the general trend was in favour of U4 and there is little doubt that it is in U4 and its derivative strains that there lies the best chance of improving the general quality of cotton on the Coast.

Groundnuts.

Work on selecting for a variety of groundnut resistant to wilt disease has continued. At the end of the season a number of selections were harvested and these will be made the basis of further work next season.

Cassava.

Here also the number of varieties under trial has been reduced ready for what may be hoped to be the final trial next season for yields and palatability.

N. HUMPHREY,
Agricultural Officer.

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